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MUNICIPAL ENGINEERING

VOLUME XXXIV. MARCH, NINETEEN HUNDRED EIGHT. NUMBER THREE

TRACK CONSTRUCTION IN STREETS FOR INTERURBAN SERVICE.*

By Thomas B. McMath, Engineer Traction and Terminal Co., Indianapolis, Ind.

The use of forty and fifty-ton cars upon tracks laid in city streets demands a decided change in track specifications. Track formerly laid for street railways shows several reasons for failure when subjected to this heavy loading. The most striking of the difficulties are: First, the selection of proper rail section; second, the foundation on which the track is laid.

We can learn very little toward a proper selection of a rail section from steam railroad experience, as the deflection of the rail and the distortion of its cross-section under load are not noticeable. A track laid in city streets, however, promptly shows in its destruction of street paving the effect both of deflection and distortion of rail section.

Assuming at first that the ballast is perfectly supporting the track, the deflection of the rail can be governed by a proper tie spacing. Ties can be spaced so that the distance between ties is a little more than the width of a shovel. This is the practical limit to permit of good tamping and maintenance. With hewed ties as ordinarily furnished under a contract for 6x8-inch ties, the average space between ties spaced 2-foot centers is about twelve inches. Instead, however, of an arbitrary spacing of 2-foot centers, the writer would advocate a specification to make the space between the ties uniform, and if this be made, the factor for tie spacing, instead of an absolute number of ties per rail, a road bed of more uniform supporting qualities will result.

The following elements occur relative to the selection of a proper rail section: 1. Maximum life of rail under traffic. 2. Economical distribution of metal in section. 3. Safety to car, passengers and public. 4. Economical expenditure of energy in moving load. 5. Least obstacle to wagon traffic.

The public generally feel that the railway company will look out for the first mentioned requirements and the city engineer for the last. Unfortunately, the city authorities are sometimes apt to assume that the use of an absolute section is necessary on account of this last requirement. However, the public is just as interested in the other requirements.

An economical rail section means reasonable operating expenses, which promptly show results in the comfort and safety of passengers. It is not necessary to dwell on the condition of rolling stock and general disgust of the public when a property can not be kept up due to maintenance being in excess of income. Compare the number of persons carried daily on our city cars with the number using the streets in vehicles and you will easily see that perhaps 90 per cent. of the people use the street as car passengers only, and 10 per cent. use it in a vehicle. The public are therefore as greatly interested in the safety of the car as the railway company.

The T-rail is the best shape that heavy interurban cars can be safely and economically operated upon, and if properly selected will answer all of the above requirements. For streets paved with brick any section deep enough to provide a sand cushion under the brick can be used successfully. The 80-pound standard section, having a depth of 5 inches, can be successfully used. The high T-rails

*From a paper before the Indiana Engineering Society.

can also be used. Many of the old high T-sections, however, are not adapted for heavy loads, due to weakness in the web, having been designed for lighter loading. If used, the bending of the web throws a crushing strain on the paving, which gives way. The 7-inch T used in this city was specially designed with web stiff enough to support the load, the 9-inch girder section having failed utterly in this requirement.

The rail requirements are: Sufficient width of head to protect paving from the wheels, sufficient height to permit paving, base wide enough to sustain and distribute load, web thick enough to resist the bending moment of the wheel load when applied at the extreme edge of the head.

Ballast is usually depended on for the foundation of the ties, if the soil is sand or gravel, but enough ballast to tamp is necessary. Clay or loam requires heavy ballast. A good foundation can be made by putting in a layer of ballast, stone or gravel, thoroughly rolling, and then laying the track and tamping with ballast, filling finally with concrete to the height required by the paving. Concrete makes the best foundation and ballast. However, concrete to be useful must be under the ties and as the layer of concrete will be over one foot thick, a cheap natural cement can be used with safety and keep the expense within reach. The sub-grade should be excavated to a depth of 6 inches below the bottom of the ties.

The track is to be laid on this sub-grade and raised up to grade, surfaced and lined on blocking. Concrete is made in the proportions of 1-2½-7 with natural cement and tamped specially under the ties and base of the rail and leveled at a proper grade for the brick surface.

This construction makes a rigid road bed, and if proper time be given for setting, will give a first-class road bed, and is preferable to any type of concrete beam construction.

The reconstruction of streets having tracks on which traffic must be maintained during construction can be accomplished by the use of dry concrete as a foundation. Excavate and lower the track until a depth of 6 or 8 inches below grade is attained. Then mix cement, sand and gravel in the proper proportions, 1-2-6, using no water. Throw the mixture in the track and raise track and tamp ties to grade the same as if ballast was used. Tamp until ties are solid under passing cars. When track has been properly surfaced on the dry concrete, line up the track and finish concreting with wet concrete. Some five years' experience with this type of work has shown that work so done will hold to surface and line as well as if laid on wet concrete without traffic. Excavations made show that the dry concrete has set, perhaps not 100 per cent. of the strength of properly wetted concrete, yet if liberality has been shown in the amount of cement used, such dry concrete will be ample. The feature accomplished is that the track is in operating condition all the time and at the end of six months an expert could hardly tell upon excavating but what the concrete had all been given the same mix.

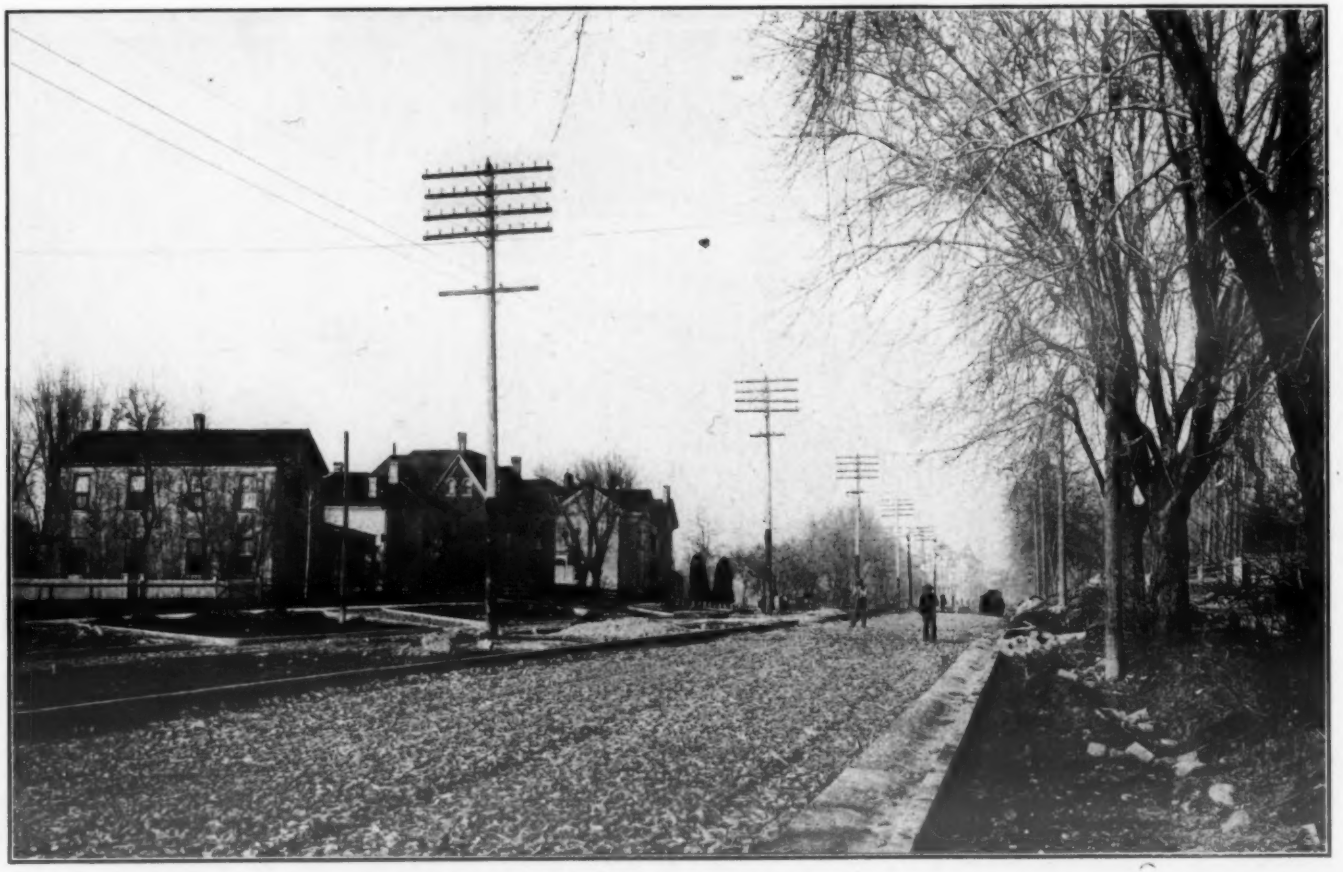
Portland cement gives better results than natural cement, but the cheapness of the latter allows a liberality in its use which is necessary when dry mixing is done.

The writer has excavated gravel from a bank with a half-yard orange-peel excavator, thrown the cement on top of the bucket of gravel, dumped the bucket in his No. 2 Drake mixer, which discharged the mix directly into the ballast cars, the extra cost of 100 yards of mixed material being $67.00 above the cost of ordinary ballast. In this case the dry concrete cost about $1.00 per cubic yard ready to spread and tamp. However, gravel pit conditions did not permit this kind of work for more than three weeks, after which it was impossible to reach the mixer directly with the excavator, and a second handling was necessary.

PAVEMENTS IN SALT LAKE CITY, UTAH.

Through the courtesy of L. C. Kelsey, City Engineer, we are able to present some photographs of streets under construction and completed in Salt Lake City, showing the various kinds of paving materials used and their application to the conditions in that city .

The first two photographs show the macadam pavement on Sixth East street, under construction and completed. Salt Lake City streets are very wide (132 feet) and the pictures show the division of the width into two sidewalks with wide lawns, two roomy roadways and a wide place for parking in the center in which the



SALT LAKE CITY PAVEMENTS.

1. Macadam on Sixth East Street under construction.

telegraph poles are set. Mr. Kelsey has the following to say regarding macadam in one of his annual reports:

During the year contracts were let for constructing 75,600 square yards of macadam street paving of which some 5,300 square yards of the contract covering Sixth East street was completed. Macadam, in so far as a material for the paving of streets in Salt Lake City is concerned, is still in its infancy, nevertheless macadamizing as a method of paving city streets is being largely abandoned in various places throughout the country.

The work of macadamizing Sixth East street from South Temple to Third South street is well advanced, the roadways consisting of a bottom course five inches thick and a wearing surface four inches thick, making a total thickness of nine inches. The lime rock used is taken from what is known as the Old Pascoe Quarry, near the Warm Springs, crushed by the city, and delivered to the contractor at a cost of 65 cents per cubic yard, plus the cost of transportation betwen the quarry and the point of delivery; the hauling was done by the Utah Light & Railway Company, and the cost was governed by a contract entered into between the city and said company. Too much should not be expected from this particular portion of macadamized street, as it is not in every way as satisfactory as it should be, owing chiefly to the fact that for some cause it was absolutely impossible to obtain rock which was crushed to the proper dimensions, and while the specifications designate that no fragments shall exceed four inches in their greatest length, yet it was not at all uncommon to find quite a large per cent. of the rock delivered so large that it would not pass a 10 or some even a 12-inch ring in its longest dimension, and varying in thickness from two to three inches. Each and every such fragment of rock must lie in the pavement flatwise and should perchance the wheel of a loaded vehicle pass directly over one end of such a slab of stone it will act as a lever by whose movement the adjoining particles will be disturbed for some little distance about same. A few stones loosened in this manner and pounded around by the impact of the wheels have a tendency to loosen others, and at the same time to loosen the binding material, which is more quickly blown away and washed off by the rain.

One important factor which enters into the question of adapting macadam as a material for the paving of streets, and which will perhaps come as a surprise to many, is the cost of maintenance. It is a mistaken idea that when a stone road has once been properly constructed no further work is necessary. As a matter of fact, the actual cost of a macadamized street is not fully realized until after it has been open for some length of time. It is of the greatest importance that the completed street should receive constant care and attention in order that any defect which may appear may be immediately repaired before serious damage is done. In the maintenance of macadam it should always be remembered that "A stitch in time saves nine," and that the work of repair should be commenced as soon as the frost goes out of the ground in the spring.

Narrow-tired wagons, such as are in common use about the city, are especially detrimental to macadam streets, as ruts are quickly formed, which if left unrepaired will soon form into long hollows and considerable work will be required in restoring them to a true surface. Small depressions, which allow water to stand, should be filled up even with the surrounding surface with smaller size of stone.

Broken stone, even of the best quality, is not an ideal material for a street surface for very heavy traffic, especially if that traffic is carried on narrow tires. It is a well-known fact that any macadam surface carrying heavy traffic will wear away from the effects of the traffic, wind, rain and other causes from one-quarter inch to one inch or more every year, the amount of wear depending upon the character of the stone used and the traffic it carries. This wearing is seldom uniform over the entire surface of the roadway, consequently the streets become more or lss rough.

Considerable damage will also be done to macadam streets by clay or loam being carried onto the surface at intersections with unimproved streets. The clay or mud is brought onto the improved streets by the wheels and tends to pick up the stone from the top course, leaving a rough surface. This material is often carried along the macadam surface for several hundred feet. A lack of attention on the part of the street department can only result in constant annoyance, extra expense and ever-increasing damage.

It will be noted that cement curb and gutter is used. This is in accordance with a definite policy recently adopted, requiring them in all general street improvement work. The third photograph shows the curb and gutter on an unpaved street. The narrowing of the roadway on this street gave the curb contractor much trouble on account of the location of the water and gas mains and the extension of the curb on this street was finally discontinued.

The fourth and fifth photographs show asphalt streets under construction and completed. Mr. Kelsey says in his report concerning asphalt streets:

The city's portion of street paving consists of one-half the cost of grading in front of the abutting property and the entire cost of grading and paving at the street intersections. The abutters are assessed at so much per front foot, sufficiently to cover the cost of one-half the grading and the total cost of curbing, guttering and paving, from the curb line to the Street Railway Company's portion, in front of the abutting property.

The factors of a good and durable asphalt pavement are:

1. A well subdrained and compacted base.

2. An intermediate base, preferably Portland cement concrete six inches in thickness to transmit the load uniformly to the earth below.

SALT LAKE CITY PAVEMENTS.
2. Macadam on Sixth East Street completed.

3. An asphalt covering of wearing capacity capable of meeting all traffic conditions and of resisting the destructive agencies of extreme temperature changes and other climatic influences.

Careful study of asphalt surfaces shows that the more compact any pavement is the better its wearing qualities. The question as to what is the steepest grade on which it is safe to lay asphalt has received a great deal of study. As a rule, however, asphalt should not be laid on a street that will be subject to any material amount of traffic on grades exceeding 6 per cent., for there must be certain times of the year when they can be used but little and with considerable difficulty. On residence streets, however, where traffic is light, the people as a rule are willing to put up with the inconvenience of the slippery streets on a comparatively few days of the year for the sake of having a smooth, clean, noiseless pavement for the remainder of the time. Asphalt itself, contrary to the general belief, is not slippery. It is smooth, and any soft substance upon a smooth, hard surface makes it slippery. Asphalt pavements should be kept clean and then there will be less trouble on account of horses slipping. It is well known to truckmen that horses travel on a smooth pavement much more easily during a heavy rain than in a drizzle. In New York City, where a street has been paved on a 6 per cent. grade with asphalt along on the sides and granite blocks in the center, as a rule the traffic seeks the smooth asphalt with its ease of traction rather than take the granite pavement.

Perhaps it would be of interest to know that the percentage of the materials comprising an asphalt pavement of 6-inch concrete base, 1½-inch binder and 2 inches of asphalt topping, as usually laid, will run approximately as follows: Stone, 52.1 per cent.; sand, 34.4 per cent.; cement, 6.3 per cent.; stone dust, 3.3 per cent.; asphalt, 3.3 per cent., and oil, 0.6 per cent. Thus it will be seen that asphalt forms not exceeding 3.3 per cent. of the materials of an American asphalt pavement, and ranges as low as 1.8 per cent., where asphalts rich in bitumen are used. Fully 90 per cent. of the American asphalt pavements may be termed as artificial bituminous sandstone, the wearing surface being 90 per cent. sand and 10 per cent. bituminous mastic.

An important improvement proposed for the near future is the reconstruction of Main street. This pavement is 92 feet wide with sidewalks 20 feet wide, and was paved with stone blocks in 1893 in three strips, one at each side 15 feet wide and the street railway in the center, with strips of asphalt between. As will be seen from the sixth photograph the street has several lines of poles at sides and in the center. It is proposed to change this in the manner shown in the last two plates, which give a cross section of the proposed new street and view of one of the standard light poles adopted.

It will be noted that the recommendations are that the sidewalks be widened to 26 feet each and the roadway narrowed to 80 feet; that all poles be removed from the street except the trolley poles, which are to be set just inside the curbs and used also for incandescent street lights; that there be a cement curb and gutter; that the stone blocks on the sides and in the street railway tracks be replaced with asphalt, the present asphalt being relaid also; and that the gas, water and sewer mains and telephone and electric light conduits be distributed under roadway and sidewalks as shown.

THE COLLAPSE OF THE LAWRENCE, MASS., FILTER ROOF DURING CONSTRUCTION.*

By Sanford E. Thompson, M. Am. Soc. C. E., Consulting Engineer, Newton Highlands, Mass.

My acquaintance with the Lawrence filters began toward the latter part of May, 1907, when at the request of Mr. Knowles I made an examination and report upon the collapse of a portion of the roof.

The investigation involved an examination of the concrete and the materials composing it besides a general inspection of the condition of the filter after the collapse.

The concrete was laid in three divisions: first, the floor with its inverted groined arches; next, the columns, which were dowelled to the floor by two pieces of 1-inch iron pipes projecting about 8 inches up into the column; and finally the roof of groined arches resting upon the columns and supported temporarily upon centering constructed in the usual manner for this type of work.

*Abstract of a paper before the New England Water Works Association to be published later in full in the Journal of the Association.

SALT LAKE CITY PAVEMENTS.

8. Concrete curb and gutter on Second West Street.

The roof of the filter is a series of groined arches supported on the walls and on six rows of columns and at the time of the failure 8½ bays of the floor out of a total length for the entire reservoir of 21 bays and piers for the support of 8 bays of the roof had been placed. Various causes delayed the construction and it was not until the first of November, 1906, that any concrete was laid upon the roof.

Of the roof, 7½ bays were laid before the closing down for the winter, as follows: November 2, 1906—two and one-half bays laid: November 9, 1906—one bay laid (from 2½ to 3½); November 23, 1906—two bays laid (from 3½ to 4½); December 17, 1906—two bays laid (5½ to 7½).

The forms for the two last bays (5½ to 7½) were up and ready for concrete on the last day of November, but they waited until the middle of December to get a temperature as high as 28 degrees F. in the morning with prospects of a good day.

The temperature dropped below freezing the last of November, and there was scarcely any real thawing weather until well into March. At the time the last two bays of concrete were laid, December 17th, the average temperature was just above freezing, but that night it dropped below freezing and the next day but one reached 6 degrees above zero.

As soon as the concrete was laid in the arches, they were covered with straw to a depth of 6 inches and later about 2½ feet of sand and gravel were placed on top of the straw, the two last arches being filled upon about two or three weeks after they were laid.

No permit had been given to the contractor to continue work in December.

During the winter, centering had been removed from the first three bays of the roof, leaving a length of 4½ bays with the centering in place. On the day previous to the fall, the carpenters began to remove the centers from these last bays, so that at night all of the centering was down except the half centers betwen the 7th and 8th rows of columns, the full centers in the next bay, and the four north arches between the 5th and 6th rows. The foreman carpenter told me that when he came on the next morning, April 3d, he noted that a 4 inch by 8 inch horizontal piece in one of the half centers was twisted but he did not attach any importance to it. The men began to work on the north arches of bay 5-6 when a cracking was heard, and they all got from under. The break appeared to start about the center of the reservoir, that is, about half way between the two sides, and the whole roof seemed to go down at once. Fortunately, the men were warned in time and no one was injured.

The centers are supported by vertical posts, and while at one of the columns two braces are shown running from the arch, in general, I was told only one brace was used, and this was fastened to the column at the height of the second clamp from the top. This brace, it must be noted, came against the upper part of a column which had simply its own weight and the adhesion of two short lengths of round rod to prevent its overturning. All of the columns in this last line, transverse row 8, were standing, but one at about the center of the reservoir and where the break was said to start is slightly canted. In the next row 4 piers were standing, but all of them tipped, including the pier in the row under the southwest arch. The columns in the other rows were nearly all broken. Pier 8.3, which was slightly canted at the time of the fall, was afterward pried over, and the cleavage of the base from the floor was smooth, as one would expect of a joint between concrete laid on two different days. The two steel dowels which projected into the pier had pulled out, leaving clean surfaces.

Several of the columns in transverse row 3 tipped toward the west, and a crack had opened at the top, that is at the spring line of the arch, about ½-inch wide. Three were out of plumb from 1 to 2½ inches, and these were also cracked at the base as well as the top. In the portion of the roof remaining I noticed cracks, mostly along the center line of the arch.

Examination of the Concrete.—The concrete at the time of the fall was so soft and crumbly that it could be readily pulled to pieces. At the time of my visit it was fairly hard, evidently having hardened very much since the failure. The stones, however, pulled from the concrete more easily than they should have done in first-class concrete, indicating that even at this time the concrete was not very strong. Concrete from the surface of the roof was noticeably weaker even at date of my visit than the concrete next to the centers.

Effect of Manure.—In certain places pieces from the top surface of the roof were much discolored. Examination

SALT LAKE CITY PAVEMENTS.

4. Binder coat of asphalt pavement on East Second South Street.

showed that the concrete had been in contact with manure contained in the straw, while other neighboring portions of the roof surface which were covered with clean straw were of normal color. The discolored portions, the color extending to a depth of about 1 inch, were softer than the rest of the concrete and readily flaked when rubbed betwen the fingers. Although this did not extend deep enough to be in itself responsible for the failure of the roof, the condition was such as to show very conclusively that manure is a bad thing to place in contact with green concrete, and that when straw covering is employed, it should be free from manure.

In this connection I may say that I recently had occasion to examine a barn floor of concrete and also several concrete drains in this floor which had been in use for a number of years in continual contact with manure, and found the surface absolutely hard and perfect. A tank containing manure was also in similarly good condition. The conclusion therefore may be drawn that manure is likely to injure green concrete while not affecting well made concrete after it has set and hardened.

Sand and Gravel.—The sand and gravel used for the concrete were from a pile which had been excavated from the site of the filter. This material was screened into gravel for the coarse aggregate or ballast, and sand. Four samples of the sand were taken, and two samples of the screened gravel. Examination of the sand and of its analyses shows that it is all of medium quality, containing a somewhat excessive percentage of dirt for maximum strength but none too much for water-tightness. Examination of the analyses of the gravel shows a large per cent. of material under one-quarter inch, the sample with the least fine material screening 20 per cent. below one-quarter inch, although the contract specifies, section 28, that "all particles smaller than one-quarter (¼) inch shall be screened out." The specifications require proportions 1:3:5. If 20 per cent. of the gravel is below one-quarter inch, and therefore sand, the proportions are actually 1:4:4, thus giving a concrete greatly inferior in density and strength to that required by the specifications. Many of the gravel stones were covered with a coating of very fine clayey sand, which after drying in the laboratory and screening by hand for five minutes did not entirely come off. Tests by Mr. Howard A. Carson (recorded in the seventh annual report of the Boston Transit Commission, 1901, p. 39), show one-third greater strength for concrete made from washed gravel than similar concrete made with gravel coated with a thin film of dirt. The excess of fine material tends to make the concrete not only weaker but slower in setting and hardening.

The contract specifies, Section 28, that the gravel "shall be washed if necessary to render it sufficiently clean," but this was not done.

Effect of Low Temperature.—The temperature records taken at Lawrence during the winter of 1906 indicate only a very few days at which the temperature was above freezing.

As already stated, the last arches were not laid until December 17th. On the following day the temperature dropped below freezing, and there were only a few days when the temperature was above freezing before the arch covering was placed. The covering naturally tended to equalize the temperature, so that the concrete would not then have the full benefit of the occasional warmer days during the winter and early spring.

It is common knowledge that continued cold prevents concrete from reaching normal growth in strength. Tests at the Watertown Arsenal (Taylor & Thompson's "Concrete, Plain and Reinforced," page 421), and elsewhere, the results of which are readily available, have brought out this point clearly, showing that if the temperature is maintained below freezing the cement after several months has only a fraction, on the average we may say about 1-3, the strength that it would have reached with a temperature of 70 degrees F. Even a temperature as high as 39 degrees F. retards the hardening so that the strength may not be more than 2-3 of what would be attained at 70 degrees F. As soon as any of the specimens were removed from the cold and placed in a warmer temperature the hardening was accelerated, and a strength nearly normal was soon reached.

At Lawrence the effect was similar, the concrete rapidly gaining strength after exposure to the warmer atmosphere in April and May.

Centering.—The contract specifies, Section 58,—"The contractor shall notify the engineers when he proposes to strike centers, but no centers shall be struck opposite the outside walls, until the embankment has been completed to the springing line and no

SALT LAKE CITY PAVEMENTS.

5. Completed asphalt pavement on West First South Street.

other centers shall be struck until at least five (5) rows of vaulting beyond have been completed.

The five rows of centering which are required to remain in place at all times are evidently for the purpose of allowing the concrete to set and also to take up the thrust of the arches due to temperature or unequal loading. The contractor evidently assumed that the provision was only for the purpose of giving time for the concrete to set, for he was removing the forms with no diagonals left in place except a few braces placed against a row of piers which had only their own weight to keep them in an upright position.

Without attempting to analyze the thrust of the arches, it is evident that if the half center at the end had been loaded with earth to the full height, it would have balanced the pressure from the next arch, so that the line of thrust from all the arches would have come directly into the piers. However, in filling a roof like this, the earth cannot be carried square to the edge, but slopes off, probably in such a case as this at a slope of 1 to 2 or 1 to 3, so that there must be a thrust from the arches beyond it if they are unsupported.

The assumption that the thrust was a factor in the fall is strengthened by the facts that (1) one-half of the bay betwen transverse column rows 3 and 4 was laid as late as November 23d, thus having only 12 days more to set with the temperature slightly above freezing than the outer bays, and yet this bay suffered the removal of the form without apparent damage; (2) the bay between transverse column rows 5 and 6, half of which was laid on the final date, December 17th, 1906, did not fall on the day when the forms were removed from the first portion of it, although unreinforced concrete falls quickly with but slight warning; (3) warning of failure was given by crushing of centers and apparently commenced in about the middle of the reservoir near pier 8.3, which was tipped from the thrust of the diagonal braces against it.

Causes of Failure.—The data presented enable us to reach definite conclusions in regard to the causes which contributed to the failure.

The design of the groined arch roof is one universally endorsed, being similar to that adopted with satisfaction in many other filters built from the year 1895 to the present time. It is consequently impossible to attribute the failure of the Lawrence filter roof in any way whatsoever to the design.

The causes of the failure therefore must lie in the construction. After removal of the forms supporting the roof the fall appears to have been due to a combination of two causes, neither of which alone would probably have occasioned the accident.

(1) The thrust of the arches;

(2) The weak condition of the concrete because of—

(a) Low temperature, which retarded the hardening;

(b) Improper screening of gravel producing an excess of sand which tends to make concrete slow in hardening;

(c) Dirty gravel, reducing the strength of the concrete.

All of these sources were probably contributory to the fall. The subsequent hardening of the concrete indicates that no trouble could have ensued if the forms had remained for a longer time and until more arches had been placed.

EFFECTS OF A REDUCTION IN THE PRICE OF GAS.

By William D. Marks, Consulting Engineer, New York City.

Some of the worst managed gas works in the United States are the most profitable, while others managed with conscientious care and greatest skill are the least profitable. The reason for this statement appears when we recognize the fact that all public service corporations usually grow in bulk and profit earning capacity rather in proportion to the community which feeds their treasury, than according to the economy or technical skill of their managers. The community in which a gas works is located places limits to the growth of its total sales and consequently to the reductions possible in the cost and price of gas.

At a population of about 75,000 the character of the demands of American

SALT LAKE CITY PAVEMENTS.
6. Main Street at present.

towns changes markedly. Below that figure the limited business of a town renders small economies necessary to its inhabitants. At or above 75,000 the town changes into a metropolis (or mother city to the surrounding country and villages), great factories and office buildings arise, theatres and places of amusement multiply. Life becomes strenuous and extravagant and hours of activity stretch far into the night.

Generalization, or what is still more unreliable, averages deduced from unclassified precedents, are of no value for single instances, where accurate figures must be predicted from a change in the price of gas as affecting the consumption or sales per capita.

A careful distinction must be made between the gross annual sales of a gas works and its sales per capita. The latter is an index of the willingness of consumers to use gas, while the former only fixes the total volume of business regardless of the attitude of the consumers, who may feel themselves outraged by the extortion of a monopoly and consequently use as little gas as possible. Just here is where a gas manager may show his ability, for it is within his power to increase the sales per capita to the limit of his community although obviously he cannot increase or affect the growth of the community which he serves. Published figures of the Boston Consolidated Gas Co. can show how and why with 16-candle power gas (18 at works) this company has paid 7 per cent. with gas at 90 cents, 8 per cent. with gas at 85 cents and proposes to pay 9 per cent. with gas at 80 cents per thousand.

The capitalization of this company has not been increased with its marvellous increase of sales from 3,000,000,000 to about 4,200,000,000 cubic feet per annum in two years. This advantage in capital required is perhaps due to the large capacity of the gas works erected in excess of needs, remaining after the orgies of high financiers for which Boston has been notorious for the last score of years, and now happily terminated by wise legislation. Since the investment (capitalization) has not been increased with the sales of gas, it has, without any reduction of the cost of gas at the consumer's meter, reduced the investment per annual thousand of sales and so has enabled payments of larger dividends from reduced profits and prices upon each thousand sold. It is to be reasonably expected from the record of its able manager that the cost of gas will be so reduced in the future that Boston will have 80 cent gas and the gas company 9 per cent. dividends with an annual surplus of 3½ per cent. ($500,000) remaining to provide for extraordinary and other expenses.

Those contemplating a reduction in gas prices in order to obtain increased sales per capita, very properly ask "What will the result be?". My reply is that unclassified averages are of no value whatever, but that classified averages will in a general way predict closely the commercial result of a reduction. In deducing an average, a knowledge of the characteristics of the communities selected by reason of a near equality of population to the one involved must be had from experience.

Perhaps one of the most interesting cases whose average results will hardly be exceeded elsewhere is the Borough of Manhattan of the City of New York. Referring to "Finances of Gas and Electric Light and Power Enterprises," page 39, it will be seen on the chart that a "gas war" began May 1st, 1899, and ended May 20th, 1900, and that the New Amsterdam company reduced the price of gas to 50 cents and the Manhattan Island companies to 65 cents. The average result of this war was the sale of gas at 85 cents in 1899 and at 82 cents in 1900. As the figures used are annual, the period of two years must be allowed for the increase of sales per capita resulting. The sales per capita at $1.15 were 6,595 and at 82 cents were 8,129, an increase of 1,533 cubic feet for an average reduction of 30 cents to 33 cents during a period of two years.

In a rudely approximate way we can algebraically express this relation:

Let Y = the sales per capita for the previous year.

Let s = the sales per capita at the end of two years.

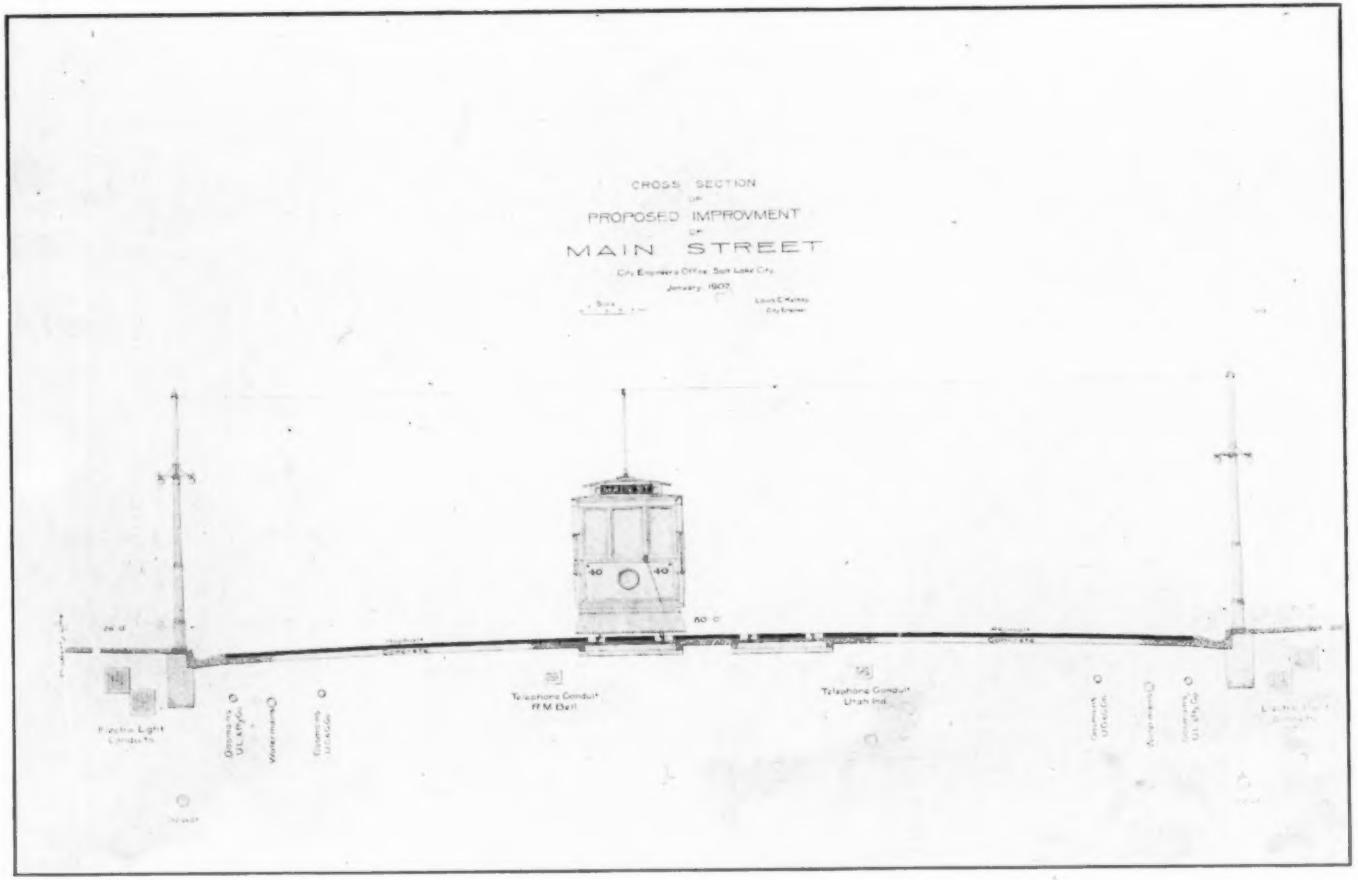
Let P = the price of gas per M, for the previous year.

Let p = the price of gas per M, to be fixed.

We have from the chart the following expression:

$$s = Y + 46\tfrac{1}{2}\ (P - p.)$$

With gas at 80 cents we would have $s = 9{,}250 + 46\tfrac{1}{2}\ (20) = 10{,}180$ cu. ft. at the end of two years. This is under the assumption (only commercially approximate) that each cent of reduction of price in New York has been proved by actual experiment to produce 46.5 cubic feet increase per capita of sales and will do so with sufficient accuracy for practical purposes in the future.



SALT LAKE CITY PAVEMENTS.

7. Cross section of Main Street, proposed improvement.

If we use 31½ cents in place of 33 we might be justified in inferring that about 25 cubic feet annual increase of sales per capita results from the reduction of one cent. As the population of Manhattan is increasing at the rate of 50,000 per year, the gross annual sales would also be increased by this extra amount.

Results as favorable as in Manhattan can hardly be expected in other metropolitan cities of the United States.

Notwithstanding all these favoring conditions, which should have led the Consolidated Gas Company of New York to voluntarily reduce the price of gas, it has been and still is engaged in a desperate and irrational attempt to extort $1.00 per thousand for gas from its consumers. This resistance has been made possible by the inexpert legislation submited by the Stevens Commission, who arbitrarily fixed the exact price of gas at 80 cents, forgetting that they were in justice to the Consolidated Gas Co., bound to go further and fix the price of coal, oil and labor with equal exactness, if they did so. Apparently this body was unaware of the happy solution of the problem of prices and dividends found in the London sliding scale, long ago.

The Gas and Electricity Commission (now abolished) approved of this legislation so far as the price of gas was concerned, fixing 22 candle power gas at 80 cents and the total value of gas plant at less than $30,000,000. This action was another instance of the crudity of inexpert legislative commissions, for they too, were not acquainted with the art of gas making, or previous legislation in England.

In his recent opinion Justice Hough, assuming as legal the present value of duplication of the property of this company, (including pavements laid by the city of New York over gas mains and services, and including proven extravagant estimates of old and worn out works obsolete as to apparatus from the progress of scientific gas making), fixed the tangible assets at $47,000,000 ,making no attempt to find the true or original investment of the stockholders), and the company's profit on tangible assets at 6.45 per cent. Regarding the value of the franchise, the Justice was on principle opposed to any valuation of this gift of the citizens to the company, but as a matter of precedent finally computed $12,000,000 as franchise value on the basis of an $8,000,000 distribution of franchise stock at the time of the consolidation of 1884, which was water only. As a matter of fact the Consolidated Gas Company in 1905 made, according to Justice Hough, 6 per cent. on $47,000,000 tangible assets and $210,000 more than its franchise tax on its franchise, if it has any.

But few gas companies are so very fortunate as to be located in a metropolis, and the majority are located in communities where the response to a reduction in price is not so great or so prompt. Referring to page 215 of "Finances of Gas and Electric Light and Power Enterprises," we find the following equation deduced from the reports of about 60 gas companies of Massachusetts for 1901.

$$p = \frac{361{,}800}{s + 1{,}225} \text{ or } s = \frac{361{,}800}{p} - 1{,}225$$

in which

p = the price per M of gas in cents.
s = the annual sales per capita.

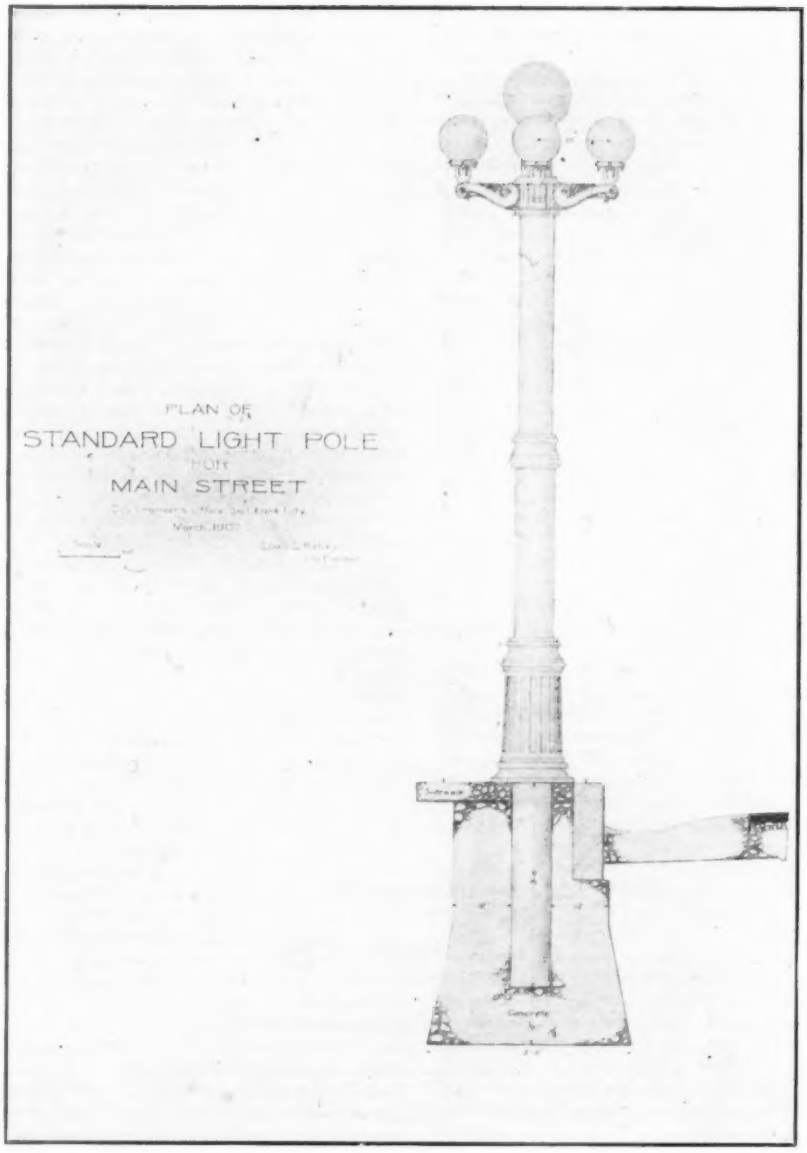
Tabulating the result of this rude equation of an equilateral hyperbola, we have for towns less than 75,000 population:

Price of Gas	Annual Sales Per Capita cu. ft.	Annual Increase Per Capita cu. ft.	For Each One Cent About cu. ft
$2.25	383		
2.00	584	201	8
1.75	843	259	10
1.50	1,187	344	14
1.25	1,669	482	19
1.00	2,393	724	29

These average results apply closely to towns ranging from 2,000 to 75,000 population in Massachusetts, and the relation between price and sales per capita appears not to be much affected by the size, but rather by the characteristic industries of these towns.

The brilliant example of the Boston Gas Company of late years cannot be used, for it has just been rescued from chaos and rascally financiers and its averages are not settled. In the case of New York City, however, we find that unintentionally the Consolidated Gas Company has proved that a reduction of one cent in the price of gas will produce an increase of sales per capita of about 25 cubic feet annually.

These classified averages must not be used for exact results, but they show very clearly the general tendency of price reduction to produce an increase in sales per capita regardless of population or previous existing sales per capita. That the idea of "a point of saturation" is rational is disproved by all experience. It is nonsense. Consider natural gas sales. The limitation of the sales per capita lies in the cost of production of gas, which is affected



SALT LAKE CITY PAVEMENTS.

8. Standard lamp post proposed for improvement of Main Street.

by many factors differing in each locality and requiring a special knowledge and technical education for their consideration.

In making use of the London sliding scale properly in a given locality it is necessary to ascertain the cost of making and distributing gas, and the true cost of the investment required for each annual thousand of gas sales. If we multiply the investment per thousand by the standard percentage fixed, we obtain the amount to be added to the cost of each thousand of gas sold in order to obtain its proper price. This procedure fixes the standard price and the standard dividend. We have noted in the unusual case of the Boston Consolidated Gas Co., that owing to excessive capacity increased annual sales reduced the investment per thousand sold. If, however, the capacity of the works is equal only to the annual sales an increased investment must be allowed with increased sales.

The hope of increased dividends with a reduction of the price of gas depends entirely upon the ability of the company to reduce the gas cost at the consumers' meter and the investment per annual thousand of gas sales.

This reduction in the cost of gas is assumed in the case of Boston to be divided equally between the consumer and the stockholder, by reducing the price of gas by one-half the reduction in its cost, and giving to the stock holder in dividends the remaining half.

To illustrate: Assume the investment per annual thousand sold in the largest gas works to be $2.00 and the present cost of gas to be 54 cents. If we allow an annual profit of 7 per cent. we have:

Cost of gas	54 cents
7 per cent. on $2.00	14 cents
Standard price	68 cents

If as appears quite possible, the cost of gas in this case of large sales may be reduced to a minimum of 46 cents per thousand, the sliding scale would be as follows: 1 per cent. of $2.00 equals 2 cents. For a reduction of cost by 4 cents and price by 2 cents to 66 cents the profit, if capital equals cost, could be 8 per cent. and for a price of 64 cents could be 9 per cent. and the cost of gas 46 cents.

It must not be forgotten that the ingenuity of all concerned in the works will be exerted to reach an increased sale without an increased investment, thus promoting the economy of capital expenditures in the hope of reducing the investment per annual thousand sold.

In England, ¼ of one per cent. in respect of 10 per cent. capital and ⅛ of one per cent. in respect of 5 per cent. capital for each penny reduction in the price of gas, is allowed to be added to the dividend. Either an equal division of profits is not intended or a margin of a fraction of a per cent. is intended to be added to the insurance and reserve funds until they reach the usual 5 per cent. of the capital, when another reduction of price occurs, these conditions favoring the consumer rather than the stock holder.

In Widnes, England, 19.56 candle power gas is sold at 38½ cents per thousand and costs to make and deliver at the consumer's meter 26.7 cents, the profit per thousand being 11.8 cents. The works have about a million cubic feet daily capacity, capitalized at $2.11 per thousand sales and average 5.7 per cent. upon the capital.

The National Civic Federation Report incorrectly states the low cost and price of gas to be due to the high price of residuals sold to neighboring chemical works, in Widnes. Mr. Isaac Carr, the masterly engineer and manager of these works, writes me, "I have no special advantage over my competitors" and then explains his exceedingly perfect business and technical methods of managing so as to produce his results attained for many years.

It is worth while to advise engineers that any information found in the Civic Federation Report is presented in much better shape and in larger quantity in Field's "Analysis" or the Gas World's "Annual Analysis of Gas Enterprises." Both of these publications much illuminate the subject of gas making under wise legislation.

Entire publicity is the safeguard against "high finance" in corporations, which has reduced the price of gas in England. Reeson's "Gas and Water Acts of Parliament," and Michael and Will's "Law Treatise," give the legal and technical conditions controlling these public utilities. They should be used as text books by every public service commission because they embody a half century of experience in fields upon which our new commissioners are now entering for the first time, and so far have blundered in most instances.

GOOD PAVEMENTS AND HOW TO SECURE THEM.*

By J. W. Howard, Consulting Engineer, New York City.

You have visited handsome cities at home and abroad, handsome and successful because of their well equipped streets. You have compared the attractive parts of such cities with opposite conditions in other cities and often wished you all had handsome and efficient public squares and streets in your home city.

Pavements of sidewalks and roadways are an economic and social necessity. The question of cost is a relative one. A community without pavements cannot preserve its existence. It cannot compete with other places thus properly equipped. The lack of pavements or the presence of bad pavements impedes the moving of people and materials and injures a city in many ways. Street cleaning is impossible. Comfort and health are endangered. The character, education and success of the people are retarded.

The paving problem involves many things; among them are the first cost of a pavement, the cost of maintenance in constant good condition, renewals, cleaning, sprinkling; expense to citizens for traction or transportation of loads over smooth as compared with rough pavements; repairs to vehicles, harness; number of horses needed for a load or the load possible for each horse to draw and at what speeds; wear on horses, effects of wet, dry, cold and hot weather; noise of some pavements; injury from street dust, more from some pavements than from others.

The use of more evenly laid, smoother and quieter pavements has increased in every city for many years.

The best pavements are obtained and maintained by employing honest, experienced and efficient men and by eliminating so-called practical politicians whether office holders, party managers or others: Paving contractors and the men who supply paving materials must include in their charges against a city or taxpayer not only the cost of construction, materials, tools and labor, but also any amounts they expend for bribery (called graft by many people), and political contributions; thus either increasing the cost of pavements or making their quality bad. If printed forms of contracts and complete specifications are prepared by a competent paving expert, not under local influences, the community receives the benefit of the experience of many other places. If the specifications are published and enumerate the preliminary, laboratory tests which the paving materials must meet and fully describe the materials, methods and processes, then, with honest inspection, economic, good and durable pavements will be the result.

Many cities lack tabulated statistics covering past experience in paving. Much more money is wasted by injudicious use and repeating poor methods than is needed to pay an expert and save in addition many thousands of dollars for the community.

Records of pavements should be analyzed and tabulated upon a basis of the square yard, which is the unit of measurement in general use. The cost of first construction, materials, labor, repairs and administration should be distributed by the square yard, kinds of pavements, etc. The traffic should be counted and recorded in quantity of vehicles and tons per foot of width of roadway. The cost of cleaning should likewise be reduced to a proper basis of comparison. If a record is kept of the first cost of a pavement, repairs, interest and other expenditures, a city soon learns which pavement is cheapest and best under given conditions.

As a financial investment nothing gives better returns than handsome, well paved streets. Besides being a benefit to property and business they retain old inhabitants, attract visitors, obtain new citizens. People leave places because of disagreeable, improperly paved, dirty, noisy and repelling public squares and streets. In every city people leave poorly paved disagreeable street districts for the more attractive and better paved sections of the same city.

The baneful influence of some streets on morals is shown by dark, crooked, narrow, obscure streets and alleys which foster physical and moral disease. Many parts of Paris, London and other cities, large and small, have introduced broad avenues in a "Latin Quarter" and "East End" or an "East Side" with splendid results.

*From an address before the Civic Association of Morristown, N. J.

The next division of the subject which I will briefly outline is that of general principles of construction of pavements.

Foundations are needed for all pavements to make them durable. These foundations are generally of concrete made with crushed stone or clean gravel, mixed with a mortar of hydraulic cement and sand. Other foundations are made from crushed stone held together by bituminous cement, some foundations are of large broken stones, packed with smaller ones. Old pavements of cobble stones, stone blocks, macadam and gravel are often used for foundations by first covering them with a thin bituminous concrete. This is true economy for a community which has already paid for and possesses such macadam or other old pavements and uses them for foundations of new and improved pavements.

The wearing surface should be of materials which will meet the special requirements of the special street where used and which can be quickly and economically repaired at long intervals when needed.

The materials used with varying good and poor success for pavement wearing surfaces, arranged alphabetically, are as follows: asphalt of various kinds; asphalt blocks; basalt blocks; bitulithic pavement; boulder stones; bricks of various kinds and shapes; cement concretes; cobble stones; dolerite blocks; oyster shells; granite blocks; gravel; limestone blocks; macadam; sandstone blocks; scoria or slag blocks; syenite blocks; tarred and oiled macadams; trap blocks; wood blocks.

Without going into details, I will briefly mention a few characteristics, etc., of several kinds.

Macadam roads were practically the invention of James L. Macadam near Bristol, Eng., in 1816. His system was to lay a stratum several inches thick of small broken stones. While he deserves praise as a pioneer of road construction, his system was soon shown to lack stability, permanence and economy. We too often repeat the experience of a century ago and think that by spreading broken stone we are making a road.

Thomas Telford began road building about 1803 and constructed many miles in Scotland and the broad highway from London to Liverpool. He introduced foundation of large broken stones, about 6 inches in size set close together with the interstices filled with small stones. Upon this foundation he spread what is practically a macadam surface of fine crushed stone. Further details are not called for here. They would show what kinds of rock or stone are best suited for macadam surfaces and how those surfaces are best laid and maintained.

Macadam road surfaces are suited only for suburban and outlying districts. In the interior of a town they become dusty, muddy and quickly worn out. Macadam is the most expensive of all pavements to keep in repair, even under moderate conditions of weather and traffic. The total cost of a macadam pavement including first cost and maintenance, is generally greater than that of permanent pavement of other materials.

Stone block pavements are made of various kinds of stone. Granite and certain granitoid and syenite rocks make the best stone block pavements. They should be laid on concrete or other solid foundation. The joints between the blocks should generally be filled with gravel and pitch. Granite block is a durable pavement and suited to streets for slow driving and where noise is not objectionable. Other stone block pavements of dolerite, basalt, trap, sandstone, limestone, boulder and cobbles are, with a few exceptions for local reasons, not to be encouraged. They are rough, noisy and not desirable.

Paving bricks of scoria, slag, fire-clay and shale are used with varying success. The best are none too good. Where brick pavements are found to be desirable, avoid fire-clay if possible and seek shale paving bricks. Use large block size, repressed and which will pass the standard laboratory tests before use.

Such shale bricks, if laid on a 6-inch concrete foundation, with the joints of the bricks filled with strong Portland cement mortar or grout and otherwise properly laid, will make a good pavement for medium traffic, if there is no objection to its noise, and where fast, sure-footed driving will not be required. Brick is suited for certain streets of almost every community.

Asphalt pavements are of two general groups; those of Europe made from ground natural asphaltic limestone, heated and compressed in place; and those of artificial asphaltic sandstone used in American cities and made by mixing sand with a little powdered stone and asphaltic cement or prepared bitumens, then compressing the mixture in place. There are several sources of supply of asphalt materials competing with each other and when

properly prepared make good pavements. Asphalt pavements are sanitary and good on many streets of large cities but for small towns they are likely eventually to get out of repair and remain so for long periods of time, because of the lack of facilities for making prompt repairs without which an asphalt pavement often becomes beyond economic repairs.

Bitulithic pavement is a form of bituminous pavement made with special mixtures, prepared by special machinery. Bitulithic pavement practically consists in a foundation of either concrete or crushed stone cemented with a bituminous cement. Its wearing surface is a very dense mixture of graded, comminuted, crushed stone, etc., mixed with a bituminous cement and compressed. This successful form of pavement is durable, dense, slightly elastic and not slippery. It is suited to many avenues and streets for general traffic while at the same time it permits pleasure carriages and automobiles to travel at fast speeds without slipping of horses or skidding of wheels.

Tar, asphalt and oil macadams are practically mixtures of ordinary macadam stone with tar, asphaltum or heavy oil in the mass or on the surface. They are crude substitutes for denser and more durable pavements. They soon become uneven and unattractive.

Portland cement concrete pavements for roadways have been tried in several places under their proper or proprietary names. They are wrong in principle and a failure in practice. They are not elastic but are rigid and brittle. The shock of hoofs and wheels loosens the stones from the concrete and grinds the cement and finer particles to powder. Wet, dry, hot and cold weather cause rapid disintegration and cracks. Concrete is suited to sidewalks under foot travel but not to roadways subject to horse and vehicle use.

Wood block pavements are of two general classes; those of round cedar or other blocks formerly used in a few western cities as a temporary pavement, and the carefully cut and creosoted or otherwise treated blocks of long leaf yellow pine or other suitable wood, laid on concrete foundations. Wood block pavements require great care for constant maintenance. If neglected they become an impediment to travel because of holes and a menace to health because of the zymotic germs of infectious and contagious diseases which they foster and distribute. Wood pavements are a luxury for a few wealth lined streets of large cities where a quiet smooth pavement is desired without regard to cost of construction and constant repair.

No one kind of pavement is suited to all cities and to all streets. Each street or group of streets should have the kind of pavement available and best suited to it. A study of the relative location, traffic, present and prospective uses of a street indicates to an experienced street engineer, the kind of pavement to use on that street.

There are three periods in the history of paving of a city. First, ignornorance and apathy. Second, empiricism or rule of habit combined with conservatism. Third, the use of scientific means and methods combined with experience of other cities.

The paving problem presents three questions:

First: Shall the policy be to reduce first cost and neglect subsequent expenses? Second. Shall we seek durability only and neglect all other important items and matters connected with or affected by pavements? Third. Shall the policy not rather be to consider not only the first cost but also the cost of repairs, renewals, cleaning, sprinkling, and to give due regard to the private expenses of citizens arising from the cost of traction; also to provide for the convenience, comfort and health of the people?

Finally, permit me to suggest that your city, like many others, can best take the following preliminary steps before beginning the actual construction of new, improved and permanent pavements.

First. Have prepared complete forms of contracts and specifications, setting forth the full requirements and tests which the different paving materials and pavements must meet to be acceptable for use and describing all details of construction as well as providing for rigid inspection.

Second. Have detailed estimates made of the costs per square yard of the different kinds of pavements; such estimates setting forth separately the first cost and subsequent maintenance of pavements of each kind.

Third. Have a careful study made of each street and its relation to other streets and adopt a definite systematic plan for future pavements of practically all streets, so that the progressive and final results will be for the lasting benefit of the whole community.

Fourth. Have a special financial

plan devised, to supply the initial first cost and provide for annual maintenance of pavements and a sinking fund or other system of meeting the expense by general or special taxation or a combination of these.

Nothing encourages a community more than to have a body of its citizens such as Civic Association or Board of Trade study the problems involved, and show public officials what can be done, how to do it and help them do it.

APPROXIMATE ESTIMATES.*

By Alexander Potter, Consulting Engineer, New York City.

Misunderstandings and troubles have frequently arisen between engineers and contractors over the meaning of the term "approximate estimate," and a considerable number of law suits have resulted in which the exact meaning and use of this term have played an important if not a controlling part.

According to the standard dictionaries, the words "approximate" and "approximately" seem to be clearly defined as something "close to in quality, degree or quantity;" as something "nearly but not exactly accurate; as an approximate estimate; an approximate result;" as "very nearly but not absolutely."

In engineering work when the quantity and character of the work cannot be absolutely and definitely determined beforehand, and competitive bids are required, the standard of comparison must be an approximate one. Bidders are invited to name prices per unit of measure, the quantities being given approximately only, to enable the contractor to determine at what price he will undertake a job of the size estimated, and it is customary to state in the invitation to bidders that the quantities named are approximate only. Now out of the different understandings of the meanings of this term "approximately only" have arisen the many disputes regarding claims for extra work, questions of fraud and misrepresentation on the part of the engineer, the interpretation of contracts in general, and of what constitutes balanced and unbalanced bids.

As the engineer is usually made the final arbiter of all questions arising under a construction contract, with power to make alterations, additions or omissions, and to determine the value thereof, the engineer's understanding of the meaning of the words "approximate estimate" becomes of the utmost importance, and some general rule should be adopted defining its meaning. Unless in engineering practice there is some well established rule to the contrary, the meaning of the work "approximate" must apply in engineering contracts and specifications which we find given in the dictionaries, i. e., that the engineer's estimates are "very nearly but not exactly accurate." The writer knows of no such rule in engineering as would warrant any other meaning being applied to this term in any of its connections.

We have already stated the purpose of an approximate estimate, viz.: to obtain balanced bids for comparison in order to ascertain the lowest bidder upon any given piece of work. Unless, therefore, a uniformity of understanding as to the meaning of the word approximate exists, opportunity is afforded for misunderstanding between the parties, which, while it may be honest, is none the less troublesome and may work great injustice.

In the first place, many contracts are let under an erroneous impression as to who is the lowest bidder. It is assumed in many cases that approximate estimates are set forth simply for the purpose of canvassing bids and that the low bid is properly that one in which the summation of the items in the approximate estimate multiplied by the unit prices is less than all the others. This may or may not be true, and depends upon the accuracy of the approximate estimate. The truly lowest bid is that one in which the summation of items in the final estimate multiplied by the unit prices would have been the lowest. The necessity of accuracy and correctness in the approximate estimate is readily seen, therefore. The main object in getting bids from contractors is not merely to determine who is lowest on the

*A paper before the Ohio Engineering Society.

face of the returns but to ascertain who will complete the work for the least amount of money.

Many engineers in advertising public work specify certain quantities of work to be performed but in the subsequent contract presented to the successful bidder for his signature carefully omit the quantities advertised as approximate so that they form no part of the contract. It needs no argument to set forth how unjust and unfair this may prove to be. The advertisement and proposal should always be made a part of the contract and specifications by specific reference thereto in the contract itself.

The powers and responsibilities conferred upon an engineer in connection with public work are often vastly greater than even the engineers themselves believe or realize to be the case. The importance of setting before the contractor proper and accurate data and estimates is one which the engineer must not lightly consider. If the engineer has any thought that the specifications and estimates do not represent or are not likely to represent the true character of the work within reasonable limits, then such clauses should be inserted in the contract as will give the contractor the right to demand that for unreasonable discrepancies the work shall be paid for at cost plus a reasonable margin of profit. This may to a certain extent suggest an innovation in the manner of letting contracts but I believe that it is the only fair and just thing to do and will in the end save not only trouble and litigation, but be a financial saving to the communities or companies adopting it.

Under the average specifications the engineer is not only a court of last resort and final arbitration, with powers of final decision specifically delegated to him, but he is also in reality the attorney for the defense, for the reason that he has either himself prepared all the important and vital clauses of the contract and specifications or has inserted them from contracts which other engineers have previously prepared. It is customary for the legal representatives of the city or company letting the contracts to have little to do with the preparation of technical contracts and specifications for construction work, merely passing upon the correctness of their legal form, and not at all upon their subject matter and requirements.

The engineer is also practically a defendant in matters of dispute arising between his employer and the contractor, because it is upon the correctness of his estimates that the work is based. On this account the tendency is very strong and the temptation very great for the engineer to endeavor to "make good" his estimates by minimizing as much as possible the difficulties met in the construction of the work by endeavoring to force the performance of work which had clearly never entered into the mind of the engineer or the contractor when the contract was signed. Had it been foreseen the contractor would never have taken the contract under the conditions specified and the engineer, had he known of such conditions being present, should have forewarned the contractor, or given notice of them in his approximate quantities.

The engineer having assumed the high duties of judge, jury, defendant's attorney, and defendant in a court of last resort, should be a man of fearless justice, above suspicion or fear of himself, who will so write his specifications that he can with honor and fairness do right and justly by both the city or company who employs him and the contractor who pleads for justice in his court. Until the engineering profession will rise to this high standard and condition it can never hope to stand where its mighty works should place it, not only a peer of the other professions, but on the topmost pinnacle of them all. In none of them is there a higher or a more urgent call for fearlessness, justice and fair dealing.

Contracts written with double or uncertain meanings, evasive clauses, or unjust and arbitrary assumptions of power in the end bring no credit upon the engineer who writes them, nor profit to the corporation in whose favor they are enforced.

There are of course allowable and unavoidable variations in contracts and approximate estimates.

In the fabrication of steel, in the manufacture of machinery, and in the erection of the superstructures of buildings, there are but few and minor elements of chance which would interfere with a contractor giving such an intelligent bid that, provided his bid is a balanced bid, no harm can come either to the city or corporation or to himself by reason of a large discrepancy between the approximate estimate advertised and the amount of work which the contractor is called upon to actually perform, saving only the fluctuation in the price of labor

and materials. But in all work involving the uncertainties of excavation of any sort, whether it be in earth, quicksand, or rock, such as is encountered in the construction of reservoirs and dams, water works, sewers, railroads, canals, docks, or deep foundations, the actual cost of the work may differ very materially from what either the engineer or the contractor assumed the work would cost when the contract was entered into. The actual cost of removing earth and rock is in many cases from fifty to two hundred per cent. greater than the engineer deemed at the time to be fair unit prices for such work. In other cases the actual cost of performance of work has often proved to be from fifty to seventy-five per cent. less than the price bid upon the work, which price was based upon the best information at hand at the time the bid was prepared. often, as the work advances, the actual conditions develop a state of things which prove that the information given in the first instance was entirely misleading. On this class of work, therefore, it is seen how important it is to have the approximate estimate of quantities approach the actual quantities which are to be required to be done as closely as possible, for if on the one hand the contractor has been led to believe that there is a certain amount of material to be handled and he is being greatly overpaid for the work performed, it is not fair to the city or corporation for whom the work is being done, that it should be compelled to pay such excessive prices upon an amount greatly in excess of the advertised quantities and on which the contractor estimated his profits. While on the other hand, if the contractor has agreed to the performance of work at a price which is grossly inadequate, under the honest misapprehension of conditions, it is unfair, under the omnibus clause in the contract providing for variations, additions, and changes, to compel him to perform work greatly in excess of the quantities upon which he was willing to risk his judgment and his capital as to the value of work.

The limiting of the words "approximate estimates" to mean a quantity within a reasonable percentage above or below the amounts called for will tend to much more intelligent bidding, and also the eradication and elimination of much of the trouble and litigation now occupying the courts of this country, due to the involuntary fraud upon or on the part of cities permitting or compelling contractors to perform work at absurdly high or absurdly low prices upon amounts which neither the engineer nor the contractor dreamed he would be called upon to perform at the time of the signing of the contract.

There should be no difficulty in inserting clauses in specifications providing that when the approximate estimate shall have been exceeded by a certain predetermined percentage the unit prices bid upon the work shall no longer prevail, but that the balance of the work shall be performed at cost to the contractor plus a reasonable percentage for profit on labor and material.

Under the ordinary form of contract the engineer is now empowered to make any and such changes as he may see fit in the work. In other words, he is given such extraordinary powers of control over the contractor, that the contractor can hardly object to having delegated to the engineer the determination of what this extra cost shall be; and the city or corporation having already placed in the hands of the engineer the responsibility of conducting its work, should have no objection to vesting him with this small additional power. The writer can conceive of no difficulties arising from such a restrictive clause as that mentioned, but believes that in the end the adjustment of all inequalities under the contract, and provisions for settling them, would tend to the lowering of the cost of contract work generally.

The question will of course arise as to what this limitation in the variation of each item over the approximate estimate should be. But this is not difficult to determine. Ideas will differ somewhat, but under the interpretation of the word as given in the dictionary, they can not differ to any great extent. In the writer's judgment there should not only be a limitation upon the gross amount of the contract, but also a limitation on each particular item of the estimate. The allowance of variance for any particular item would depend largely upon the factor of uncertainty involved and should of course be greater than upon the total amount of the contract. On a single item there might be conditions of variation of as much as fifty per cent., while on the total amount of the contract the variation allowed should doubtless never be more than twenty per cent. without some readjustment of prices upon such a basis

as that mentioned, viz.: that when the approximate estimate shall have been exceeded by a certain predetermined percentage, the unit prices bid upon the work shall no longer prevail, but that the balance of the work shall be performed at cost, plus a reasonable percentage of profit on labor and material.

GRAVEL AND MACADAM ROADS AND THEIR COST.*

By G. C. Houston, Watseka, Ill.

The roads in Orange county, built under the Swope law and amendments, are either built of Mitchell limestone or what is known as creek gravel. The latter prevails in the country lying on upper Lost River and its tributaries, and the former in the remainder of the county. I regard the Lost River gravel to be the very best material for country roads. The Orleans and Livonia road, built of this material about ten years ago, has had but little repair and is in fine condition at the present time. The state geologist in his report for 1905 highly compliments this road and the material of which it was constructed. The road was built for about $1,400 per mile. Little grading beyond providing for drainage was required. The gravel was put on 12 feet wide, 12 inches deep in the center and 6 inches deep at the outer edges, and was not rolled.

Mr. A. N. McPheeters, the well-known road engineer of Orange county, informs me that he is still building roads of the same material, 9 feet wide and 9 inches deep, at a cost of about $1,500 per mile. This gravel is composed mainly of angular pieces of chert, with a mixture of small geodes. The gravel as it comes from the banks contains enough silt and other fine material to cause it to pack readily.

I recently examined specifications for a stone road in Jackson county. This road is one mile long and 12 feet wide. The metal was crushed limestone of a 2½-inch size, placed on the road crusher run, one cubic yard of metal to each lineal yard of road, costing $1.50 per cubic yard. Two steel bridges, 3,760 cubic yards of earthwork and various other small items were included in the estimate, making a total cost of about $3,600 for one mile of work. No provision was made for rolling. This is a fair sample of roads constructed in the limestone region of southern Indiana since the Swope law went into effect. While the specifications might be improved upon, roads of this plan are fairly good and give satisfaction to the farmers, who regard them as a great blessing compared with conditions of a few years ago.

I notice that roads now under construction near Mitchell, Lawrence county, are made of hard limestone, 12 feet wide, 12 inches deep in the center and 6 inches on the edges, with but little grading and bridging. These roads are not rolled and cost about $4,000 per mile. The metal is put on in three courses.

Roads under construction near Williams, Lawrence county, have the bottom course of hard limestone, 8 inches deep in the center and 4 inches deep at the edges. On top of this bottom course is placed a layer of what is known as Walter Jones gravel sufficient to make the roads 12 inches deep in the center and 6 inches deep on the edges. No provision is made for rolling. The cost of this class of roads is about $2,400 per mile.

I recently examined specifications for roads in Gibson county. These roads are built over a comparatively level country, consequently grading and bridging cut a very small figure as regards cost. The road covering is 9 feet wide and 11 inches deep in the center and 9 inches deep at the edges, put on in two courses and well rolled. The road bed is also rolled before the metal is put on. This makes an ideal country road and cost $2,700 per mile to construct. The metal (hard limestone) was shipped about 75 miles from Kentucky. Mr. E. E. Watts has

*From a paper before the Indiana Engineering Society.

made plans for quite a number of roads of similar design within the last few years.

A couple of years ago the writer made surveys and plans for about one mile of new pike to take the place of a part of the Old Bone and Lafayette state road near Oolitic, Lawrence county. Not having the figures at hand, I am not able to give an itemized statement of the cost. There was considerable grubbing and grading, and quite a number of large trees were blasted out by the roots. The top of the road bed was 20 feet wide and the metal was put on 14 feet wide and 14 inches deep in the center and 10 inches deep at the edges. Side ditches were put in on both sides of the roadway except along fills. The specifications required the sub-grade and each course of stone to be rolled. The rolling was dispensed with by the company having the work done, as it was nearly impossible to procure a roller. The metal was put on in three courses and was composed of the hardest limestone that could be procured in that locality. The cost per mile was about $5,200. I am informed the road is standing the heavy traffic very well. It was constructed for the Perry, Matthews, Buskirk Stone Company and was turned over to the county by them in exchange for the ground occupied by the old road. I regard this as an excellent road to use near small cities, but would always require proper rolling, when possible. I believe a road built as this one was built, and with the addition of rolling and leaving off the heavy grubbing and blasting, ought to cost about $4,500 per mile.

Conglomerate sandstone, or, as it is locally known, the Walter Jones gravel, attracted my attention some time ago, and I called the attention of the road builders of Martin and Lawrence counties to what I believed to be its good qualities as a road covering. I learn that it has been used to a limited extent in both counties. It costs less than limestone and for a top dressing especially I think it superior to anything known in southern Indiana. It is composed of quartz pebbles cemented together with iron ore, and when placed on the surface of a road packs well. Its lasting qualities are good.

Roads 9 feet wide and averaging 9 inches deep, such as are now built in Martin county, using this material for metal and allowing $500 for grading and ditching, can be built for about $1,700 per mile.

The only piece of Telford road that I have noticed in Indiana is on the Elizabeth and Bridgeport pike in Harrison county. I made surveys and plans for widening and repairing this piece of road about ten years ago, making the width of the metaled roadway 12 feet, and making the road covering, including the foundation, about 12 inches deep in the center and 8 inches deep at the edges. The top covering was made of crushed limestone and flint gravel. The improvement of the road cost about $1,400 per mile. I never saw the road since making the surveys, but Mr. B. Jordan, the engineer on construction, informs me that it made a very good piece of work. I can see but little difference in the Telford and macadamized roads as regards wearing qualities, but the cost item would be slightly in favor of the latter.

I have confined myself to the roads in Southern Indiana, especially to the hilly country south of the terminal moraines of the great glaciers of the ice age, for the reason that my experience in road construction has been mainly confined to that region. I have made some efforts to obtain data for this paper from the counties where bank gravel is found, but lack of time and being so far from the scene of operations prevented my getting sufficient information to be of any material value. I notice, however, in the report of the state geologist for the year 1905, that these roads have been constructed at from $750 to $2,000 per mile, but I have not been able to find out the mode of construction or the amount of material used. The roads in Southern Indiana were built under the Swope law, while many of those farther north were built under the two mile act of 1885.

The excellent turnpikes of Central Kentucky were constructed on an entirely different system. They were toll roads and built by private companies, very often with a bonus from the county.

Mr. John S. Bright of Lincoln county, who was engineer on several of these pikes during their construction, informed me, some years ago, that they were constructed with a metal roadway from ten to eighteen feet wide, and that their cost was from $5,000 to $10,000 per mile. They were mostly built before the war when labor was cheap.

In their construction no attention whatever was paid to land lines. The pikes were built as nearly straight as

possible on the best ground that could be found, and usually ran from one county seat to another.

Most of these pikes have, within the last few years, passed into possession of the public, having been purchased by the county courts after their toll gates had been destroyed by violence.

The Swope law, since its passage in 1893, has been a great blessing to the state of Indiana in general and to the southern part in particular, and most of all to the hilly country lying south of the west fork of White River, the land of Abe Martin and his neighbors. This law has enabled the state to rise to the first in the union for good roads.

The great state of Illinois is far behind Indiana in the matter of road building. The excuse generally made is that material cannot be procured. That this proposition is erroneous will be seen when we find the farmers of Newton county, Indiana, shipping stone for road building from Momence, Illinois. But the farmers on the Illinoise side of the line find this material too costly.

I recently had occasion to pass over a short piece of road in a pleasant village in the northern part of Illinois, where an attempt had been made at macadamizing one of the streets about on the system formerly used by the old supervisors some years ago. A fine lot of crushed limestone had been spread on the street on a black soil foundation. This soil is excellent for corn, but bad for roads. The stone would be excellent for roads if properly put down, but under no circumstance is it good for corn. The stone and the soil became mixed in about equal proportions and looked very much like a batch of tar macadam ready for spreading. The road as built was practically useless on account of the black mud. The corn producing qualities of the soil were destroyed by being mixed with the limestone. It is to be hoped that Illinois will fall into line on the subject of good roads in the near future.

It will probably be noticed that on the work I have described rolling is as a general thing dispensed with. This is for several reasons. In some places water is very hard to procure in the season when needed for sprinkling roads. The old roads in some places would be impassable for a roller of any size owing to the steepness of grades and uneven surface. Bridges and culverts on many of the old roads would not bear the weight of a good roller. I call to mind a piece of road in one of the southern counties that was rolled with a horse roller to satisfy the whims of Newt Plum and some of the other residents of the neighborhood. The roller did no harm on the grade, but when it was put on the metal the grade was so steep that the horses' feet loosened up more stone than the roller settled. While I would use a roller wherever practicable, I believe that where conditions exist like those mentioned we should get along the best we can without its use.

I think the road of the future in the vicinity of small cities especially, and adapted to the growing conditions of the farming communities, will be a roadway 14 feet wide, of two courses of stone, both courses as well as the sub-grade being well rolled. The lower course about 8 inches thick in the cented and 6 inches deep at the edges, composed of stones of a 4-inch size. The upper one about 6 inches deep in the center and 3 inches deep at the edges, composed of stones conforming to macadam specification, i. e. stones that can be put into the mouth, the top to receive a dressing of Kentucky rock asphalt, well rolled.

I anticipate that the good old Hoosier state will still keep in the forefront of the good road construction, recognizing the fact that good roads are the annihilators of distance; that they have made possible the rural free delivery routes, which daily put the farmers in touch with the world's doings, making possible a more intelligent, a more independent, citizenship, and remove horny-handed sons of toil farther from the hand of the political boss. Good roads have put opportunities in the way of the children, giving them access to the central high school, where enlightenment, breadth and culture are acquired. In fact, good roads have contributed and will contribute no little to the material and intellectual progress of any good old sturdy state.

EDITORIAL COMMENT

Government of Cities by Commission.

One Function of the Engineering Societies.

Professional Molders of Public Opinion.

GOVERNMENT OF CITIES BY COMMISSION.

In a recent editorial entitled "The Des Moines Plan" the Indianapolis News returns to the discussion of forms of municipal government and, after admitting that honest administration is after all the essential rather than the particular form of government, proceeds to show where the failures have occurred in the Indianapolis form, states the differences between that form and the Des Moines form, and expresses its opinion that the latter conforms to business principles, but has not been in existence long enough to show how it will work out in actual practice.

MUNICIPAL ENGINEERING has expressed some doubt of the sufficiency of the Des Moines plan and has based these doubts on the departure of the plan from business methods. The true analogue of the municipal government is the business corporation. We establish a corporation to do business which we cannot do ourselves, either because we do not have capital enough or because there is too much of it or are too many branches of it for one man to handle it successfully. We establish a municipal corporation for the same purpose, although it will spend money without the prospect of profit which the business corporation usually has.

Municipal corporations may well differ in forms of government just as other business corporations, if they are given the same opportunity to develop on their own lines, under the general supervision of their common parent, the State. Municipal corporations have usually had too much supervision in some directions. The details of some of their business forms are too closely fixed by the State, while in some respects they as well as other business corporations have not had enough supervision. They have been permitted to prey upon the stockholders and the public rather than forced to serve them. We need reform in both these lines.

The business corporation elects its directors, who elect a president and other officers who are held responsible for the proper discharge of their duties. If the stockholders take proper interest in the business and vote with understanding of the needs of the business they secure competent officers and stand a good chance of success. If they leave the operation of the corporation to others they may allow those to gain control of it who are working for their own ends rather than those of the company, in which case trouble and sometimes failure result. In other words, given a business in which success depends upon well directed effort, the corporation achieves the succes or failure which its stockholders deserve.

The directors of such a corporation cannot be changed, except by extraordinary proceedings, during the term of office for which they have been elected. The officers can usually be changed whenever their incompetence or dishonesty is discovered, those elected by the board upon the board's motion, and those appointed by the action of the appointing power. In this way the consequences of bad judgment are reduced by placing the responsibility upon selected persons, presumably the most competent obtainable, and by the opportunity of prompt removal when mistakes are discovered.

There are "pull," "graft," nepotism, in business as well as municipal corporations. The former are sometimes worse than the latter, largely because of the secrecy of operations under the present laws and the inability of those most interested in the corporation to ascertain what is going on. This is the error of lack of supervision by the State mentioned above.

The municipal corporation, being a business corporation, should be conducted on business principles and this is the intention in the Indianapolis plan. The only real departure from the above program of the average business corporation is the election of the mayor by the people rather than by the city council. The latter is the custom in England and its results seem to be generally satisfactory. The Indianapolis city council also has less

power over the details of the administration than the board of directors may exert, though it actually has no less than the board often does exert, so many boards turning over the business to the officers and only perfunctorily exercising their prerogatives in passing appropriations, approving contracts, and the like.

The Indianapolis mayor is quite as responsible, and properly so, for the proper conduct of the city's business as the president or the general manager or other principal executive officer of the great business corporation. He therefore has, and properly so, the same power of appointing and discharging his subordinates that the responsible executive of any other corporation should have.

The Des Moines plan departs from this plain business program in several respects. In the first place it elects five persons who are by the very process of nomination and election separated from each other in interests but are at the same time made co-responsible for the acts of all. This makes the placing of responsibility practically impossible in case the officials wish to dodge it, and goes back to the form of government by a city council which combines the legislative and the executive functions in one body, which is what the Indianapolis plan has rescued that city from. It is better only in reducing the number of persons and in electing them from the city at large, but is equally bad in principle.

In the second place it puts the selection of these officials in the hands of the voters at large, i. e., into the field of politics, of appeal to prejudice and whims, rather than putting it into the hands of the one man or the small number of men held directly responsible for success and therefore most interested in the selection of the most competent persons available. The less competent mayor in his individual capacity is sometimes the head of a successful city government if he has enough good sense to recognize the necessity of competent subordinates.

In the third place these officials are in office for a definite period and can not be removed except by resort to heroic measures, no matter what errors may have been made in the original choice. This is true even if the "recall" is in force, a process which is reported from California to be as likely to act against a man who is doing his duty in an an unpopular cause, as against a man who is acting against the interests of his city. An appointive official removable at will can be replaced promptly upon discovery of the error in his appointment and, even if the mayor is elected, pressure can usually be brought to bear upon him to force him to approximate to the right thing if the good elements in the city unite in demanding it.

The initiative and referendum may be excellent methods of bringing forward desirable measures or repressing those that are undesirable in the smaller cities, those not much too large to be governed by the New England town meeting, where public discussion is generally participated in, but when the larger cities are reached this method of checking the municipal officials is outgrown and thus far we have devised nothing better than the committees of "stockholders" which bear the names of Commercial Club, Municipal League, Merchants' Association, etc.

Perhaps if we restricted the voting for municipal officials to the actual stockholders in the corporation, those who pay taxes upon property of any kind, the results would be better, for, after all, the opening statement, that honest administration is what is needed, presents the case and those who are directly interested in paying the bills for the services rendered by the municipality are the most interested in their honest administration. This is doubtless one reason for the better results obtained by English cities.

It is evident that both business and municipal corporations secure the quality of administration which they deserve and it is probably true that an educated electorate would have a good government whatever its form, and therefore it is necessary, whatever the form, that the voters be educated to appreciate it and to help in making it effective. But so long as this education is in process that form, whatever its detail may be, which keeps closest to honest business principles, makes public all its transactions, and makes easy the attempt to correct mistaken in men or measures, is the one in which the public spirited, honest and competent independent bodies grouped under the general term Commercial Clubs, can have the most and the quickest influence and is therefore the safest.

Education of municipal officials is also necessary. The progress in this direction where publicity of accounts is required and they are under expert central supervision is remarkable and indicates one line of educative work in which effort will bring large re-

sults. There is more prospect of success in improving the administration of municipal corporations through the educative effect of expert State supervision of municipal financial records, not expenditures but records of those expenditures, and publicity of such records in proper form than in further experiment with forms of government. The same is true of business corporations. The State has the right to institute the offices and methods of performing these duties and will do so if public opinion demands it. The support of our present forms of city government, making such changes from time to time as they are ready for, and help in improving them by periodical exposition of their results by expert supervisors of their accounts, are the nearest things to do and therefore among the best.

ONE FUNCTION OF THE ENGINEERING SOCIETIES.

Those who are interested in technical education have been deploring the lack of breadth in the engineers' training and some have been making quite successful efforts to improve the facilities in their institutions in this regard. This problem has been a prolific subject of discussion for years in the Association for the Promotion of Engineering Education. Some have even gone so far as to say that the good old-fashioned classical education is the best foundation for an engineering education. Such a fundamental training teaches how to think and how to express thoughts, and these are really the essentials of a college education. A couple of years of the classical course can be turned from their practice in thinking and expressing in literary terms into thinking and expressing oneself in more material ways and some of the early training can be modified in like manner, if these essential results are not lost sight of.

The engineer is not like the preacher, the lawyer or even the physician, always ready to express himself on any subject in which he is interested. His work leads to repression on these lines and if he takes his proper place in the world he must pull himself out of himself and make a special effort to express his ideas and impress them upon the community.

Many of our college bred engineers need help in this direction, need a forum in which to practice. Many other self-made engineers need it still more.

The engineering society among its many functions, supplies the place, the time and the reason. Many men make just this use of an engineering society, some of them purposely but many more unconsciously.

No man gets the full benefit of membership in such an organization unless he gives to it fully as much as he takes. The conscious or unconscious recognition of this fact wakens many members who upon entering are silent but with some encouragement from the official family soon develop into active and valuable members ready to do their best in presenting their subjects and in discussing the productions of others. These men thus aroused become greater factors in their own communities. The engineering society thus supplements successfully the work of the college in this regard as well as in others.

The college professors in the state or city can do much by their example and precept judiciously applied in bringing out the latent talent in the society provided they do not overdo the matter and give the backward members the opportunity to say "Let the college men do the work, they have practice and like to do it," by filling the program so full that he thinks he is not needed.

PROFESSIONAL MOLDERS OF PUBLIC OPINION.

We have heard much in New York of certain molders of public opinion and the name has now become something like a by-word applied in various cities to those who try to impress certain ideas upon the public—for a price. Great successes always have their imitators and the drop from the sublime (?) to the ridiculous is made from Mr. Quigg to a detective agency which in its advertisement in a presumably reputable paper devoted to the interests of corporations calls attention to the rapid growth during the past two years in sentiment adverse to granting or extending franchises to corporations, and to the many agitators who have come to the front and wish to ride into office on the hobby of municipal ownership. Where a corporation wishes to renew its franchise, and agitators are causing trouble, the agency details operatives who, it claims, can and do overcome the difficulties and aid in securing a new franchise. It is stated that the operatives simply furnish information, leaving the organization to the corporation, or, if necessary, men will be supplied

who will organize the field, mold public sentiment, and remain on the ground until the new franchise is secured.

What will become of the "400" among the "molders of public opinion" if every detective agency is to take up this line of works? Forunately for the original entries such an advertisement sounds too much like that of the man who sells tips on the prices of stocks but is unable to make enough on the use of his own tips to keep him from borrowing, and so only the unwary corporation official, of which there are some, is likely to be caught, or possibly some one in desperate straits who has no Quigg among his friends and is catching at whatever straws may float his way.

When public service corporations are put under the supervision which the States owes to its citizens to give them, and all their transactions are made open and above board, it will not be necessary to make use of this kind of detective service. Such supervision and publicity will be a protection to the company as well as its patrons and to the city. It may reduce the possibilities for speculation in franchises but, judging from such results as have already been obtained, it will put the companies on a sound financial basis where values will be stable and returns certain.

THE QUESTION DEPARTMENT

Arguments on Municipal Ownership.

I am seeking condensed information in favor of the municipal ownership of public utilities, especially street railways, lighting and water. Can you refer me to any of your publications in which this view of the subject is treated and where statistics and data relating to specific cases are given? Information along this line and cost of the publications will be much appreciated.

F. H. A., Hudson, N. Y.

The volumes of MUNICIPAL ENGINEERING are perhaps the richest mine of information in this line. Practically every number contains information applicable to one side or the other of the question of municipal ownership, and as the editor has no preconceived theory which he feels bound to support the information is as nearly unbiased as it can be made from his knowledge of the sources from which it is obtained. In vol. xxi, p. 163, will be found a list of articles containing arguments against the municipal ownership of electric light plants. On the same page is a list of articles containing arguments in favor of municipal ownership of public utilities. Another list is given in vol. xxvii, p. 273. Herewith are given a few of the articles which have appeared since the above lists were made, or not included in them, which are most directly applicable in a debate. It should be remembered that to be fully equipped on one side, both sides should be carefully studied.

"Municipal Light and Water Plants at Grand Rapids, Mich.," vol. xxii, p. 370.

"Municipal Government in Germany, Its Success and Why," vol. xxiii, p. 209.

"Municipal Franchises," vol. xxiii, p. 337.

"Cost of Light in Municipal and Private Gas and Electric Plants," vol. xxiii, p. 160.

"Cost of Municipal Light," vol. xxiii, p. 168.

"Riverside, Cal., Municipal Light Plant," vol. xxiii, p. 191.

"Municipal Control Retards Electrical Development in England," vol. xxiii, p. 115.

"Equipment and Operation of Municipal Electric Light Plants in Massachusetts," vol. xxiii, p. 434.

"Investments and Earnings of Municipal Electric plants," vol. xxiv, p. 344.

"Municipal Trading in England," vol. xxiv, p. 20.

"Results of Municipal Electric Light Plant at Sioux Falls, S. D.," vol. xxiv, p. 54.

"Richmond, Ind., Municipal Electric Lighting and Power Plant," vol. xxiv, p. 122; xxvii, p. 130.

"A Valuable Report on Municipal Lighting for New York City," vol. xxiv, p. 292.

"Ottumwa's Struggles for Municipal Ownership," vol. xxiv, p. 112.

"Efficiency in Municipal Management," vol. xxv, p. 85.

"Estimated Cost of Municipal Lighting in New York," vol. xxv, p. 43.

"Costs and Prices of Gas and Electric Lighting by Municipal Plants," vol. xxv, p. 232.

A review of the report of the Massachusetts Light Commissioners for 1902 in vol. xxv, p. 47.

Reviews of the reports of the Duluth water and light department in vol. xxiii, p. 474 and vol. xxvi, p. 200.

"Management of Municipal Water Works," vol. xxvii, p. 106, and a list of previous articles on p. 113.

"Information About Gas Plants and Gas Franchises," vol. xxvii, p. 201.

A review of the Danville, Va., report on its municipal water, gas and electric light plants for 1903, vol. xxvii, p. 218.

"Results of Chicago's Municipal Lighting Plant," vol. xxvii, p. 287.

"Municipal Ownership in Santa Clara, Cal.," vol. xxvii, p. 294.

"The Municipal Conduit System of Erie, Pa.," vol. xxviii, p. 1.

"Regulation of Gas and Electric Rates in San Francisco," vol. xxviii, p. 295.

"Some Consequences of Municipal Ownership," vol. xxviii, p. 373.

"Cost of Municipal Lighting in Alameda, Cal.," and in Decatur, Ill., vol. xxix, p. 27.

"St. Louis Municipal Lighting," vol. xxix, p. 200.

"Franchises for Gas Companies," vol. xxix, p. 323.

"Municipal Franchises," vol. xxix, p. 340.

"Insufficient Consideration of Franchises," vol. xxix, p. 345.

"Governmental Regulation of Rates of Public Service Corporations," vol. xxix, p. 346.

"Some Varieties of Opinion on Municipal Ownership," vol. xxix, p. 371.

"Scope of Municipal Ownership Inquiry," vol. xxix, p. 372.

"Fixing Rates for Public Service," vol. xxix, p. 422.

"Yreka Water Works System," vol. xxix, p. 437.

"Municipal Ownership of Franchises," vol. xxix, p. 442.

"Municipal Finance and Accounting," vol. xxix, p. 445.

"Municipal Ownership of Gas Works," vol. xxx, p. 49.

"Municipal Ownership of Street Railways in Great Britain," vol. xxx, p. 266.

"Payments for Street Railway Franchises," vol. xxx, p. 276.

"Municipal Gas Works," vol. xxx, p. 346.

"Cities Owning their Electric Lighting Plants," vol. xxx, p. 354.

"Private or Municipal Ownership of Water Works," vol. xxx, p. 367.

"Who Shall Fix the Rates for Public Service Corporations," vol. xxxi, p. 18.

"Municipal Lighting Plants in Wisconsin," vol. xxxi, p. 125.

"Cost of Electric Lighting in Cities," vol. xxxi, p. 201.

"Municipal Ownership in Germany," vol. xxxi, p. 224.

"Government Ownership of Public Service Industries," vol. xxi, p. 302.

"Street Railway Situation of Detroit," vol. xxxi, p. 381.

"Personal Experiences with a Municipal Gas Plant," vol. xxxii, p. 103.

"A Weakness of Municipal Operation of Public Utilities," vol. xxxii, p. 175.

"Municipal Ownership Failures," vol. xxxii, p. 240.

"Is Municipal Ownership a Failure?" vol. xxxii, p. 250.

"The Municipal Electric Light Plant of Hagerstown, Md.," vol. xxxii, p. 291.

"Municipal Control of Public Service Corporations in New York City," vol. xxxii, p. 310.

"Report of New Jersey Commission on Municipal Government Legislation," vol. xxxii, p. 331.

"A Study of Municipal Ownership and Operation," vol. xxxiii, p. 77.

"The Ownership and Operation of Public Utilities," vol. xxxiii, p. 101.

A review of the 1906 report of the Massachusetts Gas and Electric Light Commissioners, vol. xxxiii, p. 120.

"Public Utilities Laws," vol. xxxiii, p. 178.

"New Forms of City Government," vol. xxxiii, p. 244.

"Franchise Taxation and Rates for Service," vol. xxxiv, p. 28.

Copies of MUNICIPAL ENGINEERING can be supplied at 25 cents each, some of the later number at $2 a dozen, in case they are not out of print.

Among the books containing information on the subject are "A Bibliography of Municipal Problems and City Conditions," which contains classified lists of books and articles in periodicals included under its title. This book is probably out of print but can be consulted in any library which pays attention to municipal affairs; "Municipal Pub-

lic Works" ($1.65) by S. Whinery; "American Municipal Progress" ($1.25) by Charles Zueblin; "Government Ownership" ($1); Fairlie's "Municipal Administration" ($3); Shaw's "Municipal Government in Continental Europe," and "Municipal Government in Great Britain"; Meyer's "Municipal Ownership in Great Britain."

How to Construct Underground Electrical Conduits.

Will you kindly give information through your columns concerning underground electrical conduits? Would it be advisable to have conduits for telephone wires on the opposite side of the street from conduits for electric light wires, or have them together and separated by some insulating material?

The electric light wires here carry 2080 volts, which is transformed to 104 volts before entering the houses. What are some practical methods of transformation and distribution when conduits are used?

G. A. R., Barre, Vt.

There are two good articles in MUNICIPAL ENGINEERING describing methods of construction of underground electrical conduits. One of these is by B. E. Briggs, the city engineer of Erie, Pa., and will be found in vol. xxviii, p. 1. The other is by J. Walter Ackerman, the city engineer of Auburn, N. Y., and will be found in vol. xxxiii, p. 376. These two city engineers can give information on the subject, and more can be obtained from the makers of electrical conduits and apparatus, names of a number of which will be found in the "Business Directory" published in each number of MUNICIPAL ENGINEERING under the headings "Conduits, Concrete," "Electrical Insulation," "Clay Products," "Fire Clay Products."

It will be seen from the article by Mr. Ackerman that he places high and low tension wires in different ducts of the same conduit, with proper precautions regarding insulation, induction, etc., separating the manholes into two independent sections so that work on wires of one kind will not interfere with those of the other. A satisfactory place to put the transformers on distribution lines is in chambers in the manholes or adjacent to them and reached from them.

Books for Keeping Water and Light Plant Accounts.

Will you not kindly advise me as to where I can obtain information relative to systems of book-keeping for municipally owned electric light and water works plants. Owing to the rapid growth of this city and consequent extension of the work carried on by the electric light and water works plant, we desire to improve and perfect as far as may be possible our system of accounting, with particular reference to obtaining the necessary results with a minimum of time and labor.

I. W. S., ———, La.

Some years ago MUNICIPAL ENGINEERING instituted a competition for the best system of keeping water works accounts and records. From a study of the forms presented in this contest and others a system of bookkeeping was devised which is applicable to most water works plants. The system includes the account books, metered and flat rate water register, special register, delinquent register, register of vouchers, arranged for detailed classification of expenditures, etc. An important part of the system is the card system of keeping the applications for water and the changes which are made in the services from time to time.

A series of articles appeared in vol. xix of MUNICIPAL ENGINEERING on the subject of a model system of bookkeeping for electric lighting plants. These articles give really the form of a set of books for a lighting plant similar to those above described for a water plant.

Cement Plaster.

What is "cement plaster?" What is the best construction for cement plaster on expanded metal lath for residence exteriors, using 3x4 inch studding, and how far apart should the studding be placed, using what is called B lath? If there is an expanded metal company issuing a catalogue giving the above information, which you can endorse, kindly give me the name.

J. M. P., Trenton, N. J.

Following is a specification for exterior plastering of a building, made by Vonnegut & Bohn, architects, of Indianapolis, which may cover the case.

All exterior wall surfaces, also the columns and cornices shall be lathed and plastered. All straight surfaces shall be lathed as specified for interior plastering but in addition the sheathing shall first be stripped vertically with plaster lath 16 inches apart on centers. At corners and angles the nailing shall be done with special care and with nails of twice the length of ordinary lathing nails. The columns and other surfaces not suitable for wood lath shall be covered with standard expanded metal closely nailed.

If expanded metal lath is used throughout the vertical strips or the

studding should be about the same distance apart, 16 inches.

All mortar to be of the best quality lime mortar of kind and applied as specified for interior plastering. To this add Portland cement for first and second coat and white cement for the finishing coat. All to be uniform tint to be agreed upon with the architects.

The specification for interior plastering referred to requires best quality fresh burnt lime and clean sharp river sand to which hair or fibre is to be added for the scratch work. Proportions of materials for the mortar are stated as 2½ barrels of sand to 100 pounds of dry lime and 1½ bushels of hair to 200 pounds of lime for the scratch coat and ½ bushel of hair to 200 pounds of lime for the brown coat. The lime should be thoroughly slaked in a tight box and should be run off through a wire sieve into a mortar box and allowed to stand at least 24 hours. The first coat of plaster to be put on one-quarter inch thick over the lath and should be pressed by trowel with sufficient force to squeeze it between and behind the laths so as to form a good key. The second coat to be put on ¾-inch thick.

The proportion of Portland cement to be used is not stated in this specification, but should not be so great that the surface will hair-crack. An important part of the specification is the requirement that the work be done by a firm named whose reputation is guaranty of good work and who could be trusted to supply the proper proportion of cement for good results with the sand and lime used, and to produce a good uniform tint and finish on the surface.

Firms which can supply additional information about the details of the sizes to be used will be found listed in the "Business Directory" printed in each number of MUNICIPAL ENGINEERING under the heading "Expanded Metal Construction."

Patents on Concrete Posts.

In your January number you give a list of patents concerning cement and its uses. A number of these cover fence posts or rather posts. Now what I wish to obtain is the name and address of patents issued on posts prior to list given in your January number.

I. L. G., Payne, O.

Similar lists to that in the January number appear frequently in the "Machinery and Trade" department of MUNICIPAL ENGINEERING. In 1907 they will be found in the January, February, March, May and August numbers, and each previous volume has several lists. Others will appear in future numbers. The U. S. Patent Office, at Washington, issues weekly lists of patents granted from which the classified lists of patents of interest to our readers are compiled.

Decay of Wood in Concrete.

Will timber entirely inclosed in Portland cement mortar or concrete decay? I have not found anything on the subject either in the "Hand-Book for Cement Users" or other works.

L. T., Cottage Grove, Ore.

Wood enclosed in concrete would doubtless act as it does under similar conditions elsewhere. If the concrete is always under water the wood would not decay any more than if not covered by the concrete. If always dry it may be subject to dry rot as in other cases of practical exclusion of air, and if alternately wet and dry it would follow the usual course of timber under such condition. If the concrete is water tight the second condition is likely to occur and if it not either of the three may occur. There are no experiments on record. Can our readers give us the results of any observations?

Profit in Portland Cement Manufacture.

Can you tell us whether there is any published information giving statistics as to the profit in the Portland cement industry, and if so where it could be obtained?

S. A. H., Meriden, Conn.

There is probably more information on the subject of the cost of making Portland cement in the volumes of MUNICIPAL ENGINEERING than in any other single publication. In the February number on page 99 is a list of the articles which have appeared in MUNICIPAL ENGINEERING on this subject. To the cost as given in some of these articles the cost of selling the cement must be added in order to give a figure with which to compare the price received for the cement. Mr. Eckel, who wrote several of these articles, has a book on "Cement, Lime and Plaster" which gives some additional details of the information. Some data are given in the "Handbook for Cement Users" ($3.00) and in the introduction to the "Directory of American Cement Industries" ($5.00). The question of profit in the manufacture and sale of Portland cement is so much a question of supply and demand in the locality of the mill that no general figures obtained from any source are of special

value in deciding upon any given proposition. It is an absolute necessity to make careful studies of all the conditions for each particular locality as well as to have a knowledge of the ordinary cost of making and selling cement and of carrying the plant over slack seasons before making an estimate of the dividend paying possibilities of any proposition in the Portland cement field.

Waterproofing for Concrete Block Wall.

Will you please tell me what in your judgment is the best wash to make the outside of a cement block house impervious to water? We refer to houses already built, where no waterproof material was used in mixing the cement blocks. The houses are up and when it rains water and dampness show through the walls and into the rooms although the walls were plastered right on the cement blocks. The plaster has since been scraped off and a thick coat of asphalt has been applied, and now they are studded, lathed and plastered. While I cannot state for a fact I understood at the time the houses were built (this fall) the veneer blocks were to be of a 1 to 3 mixture.

The owner speaks of linseed oil, and while this may do to waterproof a floor I don't think well of it for the outside. This party has just finished five of these houses, but none have been treated in any way except the one I have mentioned.

Any information you can give me on this subject will be duly appreciated.

G. H. S., Portland, Me.

A coating of asphalt or asphalt paint on the inside, if properly applied, will give excellent results, and it may be desirable if the outside is also waterproofed. The water on the inner side of a stone or block wall may be due to condensation of moisture in the air of the room upon the cold masonry, as well as to moisture from outside coming through the wall either through blocks or joints. The asphalt coating is not a good conductor of heat or cold and so it ought to reduce the danger of condensation as well as the danger of the passage of moisture through the wall from the outside. Plastering is sometimes done on this asphalt coating, but wire lath or expanded metal or something of that sort fastened to grounds on the wall would be desirable as a foundation for the plaster and to permit at least partial separation from the wall.

Any liquid application to the outside of the wall is of comparatively short life, as the waterproofing material must be dissolved in a liquid in order to apply it to the wall and it can therefore be again dissolved in the water which is driven against the wall in a heavy rain storm, and so ultimately permit the moisture to pass through the wall. Sylvester's process is intended to give an insoluble deposit in the wall. This process is described in the "Handbook for Cement Users" ($3.00) and consists in brief of the application of alternate coats of alum and soap applied 24 hours apart in liquid form. Chloride of calcium is also applied in coats like paint but it is soluble in water and so the coating must be replaced at frequent intervals. Mr. Farnham's article on the paraffine process in the January number shows that it is certainly excellent, although rather difficult to apply.

The subject of waterproofing is thus far in a rather unsatisfactory state so far as the treatment of buildings already constructed is concerned. Such processes as Sylvester's were developed many years ago for application to stone and brick walls and can also be applied to concrete walls. Many patented and secret preparations have been put on the market in the last four years, since the low average quality of concrete blocks has shown the necessity for them. The best of them seem to be those named above, possibly modified in form for trade purposes. There are some others which color or discolor the surface which are of different nature.

There are also several kinds of waterproofing applied in the dry or wet mixtures of cement and sand, some of which are apparently very satisfactory, but they are not applicable to a completed wall.

For names of makers of waterproofing materials for concrete reference may be made to the "Business Directory" printed in each number of MUNICIPAL ENGINEERING under the headings "Waterproofing," "Waterproofing for Cement," "Waterproofing for Concrete."

Sufficiency of Concrete Arch.

Will a concrete bridge 28 feet between piers which are 30-inch base 18 inches at top 10 feet high, roof 20 inches at ends and 14 inches in center, arch 18 inches rise in center reinforced with 36 lb. T-rails 15 inches center and barbed wire across at 2-foot intervals, stand ordinary road travel? Or should a pier be put in the center, where the foundation is rather dubious sand and gravel. Roof 16 by 28 feet contains 23 yards of 1-3-5 concrete.

S. B. R., Dequeen, Ark.

The accompanying sketch shows the T-rail reinforcement to be horizontal

rails with base at soffit of crown of arch and ends with 2 inches of top surface of arch "roof" at piers and resting on top of piers, and probably resting 1 foot on each pier.

The distribution of materials is not good and the bridge would not be safe for loads likely to come upon it in the course of highway traffic. It will be a good exercise for the young mathematicians among our readers to find out what stresses the ordinary traffic on a country road would put into the rails and the concrete, if considered independently, and as a combination, also the stability of the piers. What effect would a traction engine have on the bridge? Solutions which give assumptions of loads and some indications of method of analysis and the results will be published if sent in, with or without names as may be preferred, also suggestions as to better methods of using and placing the reinforcement and the concrete. Probably the necessities of waterway at high water require the flat arch. It would be better to make a proper design for the arch than to put in an additional pier if the foundation for the pier is doubtful. An engineer should be employed to study the local conditions as to foundations, loads, waterway required, cost, money available, etc., and make a design for the bridge. He may be able to save his fee by reducing the cost of the bridge as well as making it safe, and if an accident should occur from a defective design his fee would be covered many times by the damages for injury or loss of property.

Information About Concrete Pavements.

1. We have one street here which has a badly worn macadam on it. We have the idea that if cement pavement is practicable, that it would in this case make the best pavement for us for the money invested, as we can plow up the old macadam and use part of the cracked stone for a foundation for the pavement and use the balance in the concrete. What is your opinion on the subject?
2. What should be the total depth of the excavation?
3. How much of this excavation should be filled with cracked stone for a foundation?
4. How many courses of concrete should we use and what should be the thickness of each course?
5. What proportions of cracked stone, sand and cement should be used in each course?
6. Should the pavement be cut into blocks, the cut extending through the several courses of concrete, to the foundation; if so, what should be the size of the blocks?
7. What distance apart should we place expansion joints, filled with asphalt?
8. Should the top layer of concrete be corrugated; if so, how deep should the corrugations be, and how far apart, and should they cross the pavement both ways?
9. Would you advise the use of spelter (at about twice the cost of sand) for the top course of concrete?
10. What is your judgment as to the desirability and durability of concrete pavement as compared with brick pavement?
11. Have you knowledge of concrete streets in any towns which have been in use for any length of time? If so, please name them so that we may write to them.
12. How much crown should the street have? It is 70 feet between curbs.
13. How much do horses slip on concrete pavement compared with other pavements?

R. C., Marion, Kan.

1. Unless the macadam is very thick there is probably not more than enough of it to make the foundation for the pavement. It is already compacted as it lies and, unless its shape or its location is such that it must be removed to make room for the new pavement, it can be smoothed off to the proper form for the base of the new pavement and serve better than a new base would. This would cost very little indeed if the present pavemnt is worth anything.

2 and 3. There would then be no excavation except that necessary to bring the surface down to the level and form decided upon and this would probably be mostly scraping or surface picking.

4, 5, 6, 7, 8 and 11. Full descriptions of concrete pavements will be found in back numbers of MUNICIPAL ENGINEERING; in vol. iv, p. 229, vol. xvii, pp. 383 and 384 and vol. xix, p. 427 of the pavements in Bellefontaine, O., the first of which was laid about 1890; in vol. xx, p. 341 of one in New Orleans, La.; in vol. xxiii, pp. 335 and 400 of some in Grand Rapids, Mich.; in vol. xxvii, p. 350, of one in Toronto, Can.; in vol. xxviii, p. 386, of pavements in Richmond, Ind.; in vol. xxxiii, p. 412 of pavement in LeMars, Iowa. Much on the subject will also be found in the "Handbook for Cement Users," ($3). In some of these articles full specifications will be found. The Richmond specifications call for a well compacted subgrade such as the macadam pavement would furnish; then 4 or 5 inches thickness of concrete, then a filling of all low places and voids with fine sand, a layer of thin tar paper and the concrete wearing surface 4 or 3 inches thick of a mixture suitable for the

base of sidewalks, with an additional inch of top finish of rich concrete deposited in two layers each one-half inch, thoroughly rammed and deposited before the layers below have set. Some of the other specifications are not so heavy as that of Richmond. Bellefontaine requires 6 inches depth of concrete in two layers similar to a heavy sidewalk or driveway. Expansion joints are required in Richmond at the ends of the sections in which the pavement is laid and at the gutters. Apparently the sections may be of any convenient length for working. The Richmond specification does not define the surface corrugations. The early Bellefontaine pavements were made in blocks 5 feet square like cement walks, but experience taught that the joints or surface corrugations should be much closer together and they were made in the form of V-shaped grooves 1 inch wide and 3-16 inch deep every 4 inches, at right angles to the length of the street. The joints between blocks should be on diagonal lines across the street. Bellefontaine finds the tar paper joints about the 5-foot square blocks sufficient to take care of expansion. Richmond requires regular expansion joints, say one inch wide, filled with a bituminous filler, at the gutters and at frequent intervals across the street. The distance apart of the joints and their width vary directly.

9. It is advisable to use hard stone for the wearing surface. Richmond uses in some streets granite screenings. The writer is not familiar with the qualities of "spelter" nor its chemical or mineralogical composition as it is used in this question.

10. The Bellefontaine pavements have been very durable. In one of the articles referred to it is stated that no repairs had been made during the first ten years except on one street whose gutter was in the center of the street and wheels in it caused excessive wear. There is no reason why the street if well laid should not be as durable in proportion to traffic as driveways or sidewalks.

12 and 13. The principal objection to the pavement seems to be its slipperiness. This means that the crown must be very light. Various rules would make it from 1 foot to 1¼ feet on a 70 foot street.

Combined Curb and Gutter of Concrete.

Does the combined curb and gutter give general satisfaction, or do not horses hitched along the curb lines have a tendency to make an uneven gutter?

J. N. G., Wellsville, O.

The gutter, if properly laid is affected but little by standing horses. If the street is of macadam or is unpaved and holes are allowed to form it might be possible for a horse to knock off the edges of the concrete gutter and ultimately to destroy it, but this is the height of carelessness and neglect. The value of the gutter on such streets is that it is not dug out easily by standing horses and always presents a regular surface and grade for the flow of water and is not in danger of washing. It is of no use as a gutter if the street surface is allowed to settle or be excavated in any way below its level. The permanent gutter shows the defects in the street surface and the necessity of repairs clearly and more frequently than if the concrete gutter did not exist. This is an advantage and a point in favor of the gutter, not against it, although the average councilman who finds it necessary to repair the streets under his charge more frequently in order to keep them up to the standard set by the curb and gutter is likely to object to it because it is troublesome by keeping him constantly up to his duty.

On paved streets there is likely to be a defective line along the junction between the curb and the pavement. Sometimes this seems unavoidable though there are enough pavements where this defect does not exist to show that it is mainly a question of good materials and good workmanship. A little settlement of pavement or of gutter or a change of level due to expansion or contraction, or the quicker wear of an expansion joint are the usual reasons for the defect along the junction, and experience will enable one to overcome all these nearly every time.

How to Finish Cement Floors.

In finishing concrete floors here a mixture of 1 part best German Portland cement to 2 parts clean sand was made very wet and was spread three-fourths inch thick over floor in the morning, trowelled all day, left over night, and then trowelled all next day, some dry cement being sprinkled over the surface at times to take up some of the large excess of water. Is such long continued working necessarry or advisable?

E. SQUIRE, Claremont, Cal.

Such long continued working is neither necessary nor advisable, indeed it is detrimental to the wearing surface of the floor. While the top coat should be applied quite wet it is easy to make

it too wet. If it is made too wet or is troweled too much or dry cement is added to take up the excess of moisture the neat cement forms a surface skim which is different from the material below, will hair crack from expansion and contraction under changes of temperature or even flake off. The troweling should be completed as rapidly as possible, before the cement would have time to take its first set. Work extended over a longer period is worse than thrown away.

Fillers for Brick Pavements.

I have before me two articles from Professor Baker, of Illinois University, upon brick pavement, one in your magazine of July, 1906, the other in Clay Record, October 30, same year.

In both he discusses the "fillers" in use. In your article he speaks very approvingly of asphalt for this purpose. In the other article he does not mention it.

I wish you would give the opinion now prevailing, in regard to the merits of the asphalt filler.

L. B. N., Dixon, Ill.

Both cement and asphalt are largely used as fillers for brick pavements and both have their strenuous advocates among those who have no financial interest in the promotion of either one. In fact, the cement filler is not now subject to patent or special secret process, nor is it sold as a special article of manufacture or commerce.

There are several articles in MUNICIPAL ENGINEERING upon both methods of filling pavements. Perhaps the most complete exposition of the use of the cement filler in pavements is in the article entitled "Cement Filler for Brick Pavements" in vol. xxxiii, p. 85, August, 1907. An excellent article on the use of asphalt for expansion joints will be found in the same volume, p. 390, December, 1907.

A series of articles on various fillers starting with one by Professor Baker in vol. xxviii, p. 238, and following with articles by other engineers and contractors on pp. 294, 366 and 435 give several views on the subject. Professor Baker's article referred to in the question is on all kinds of fillers and is in vol. xxxi, p. 31. That there are several firms interested in pushing the use of asphalt fillers is shown by the descriptions of several of them in articles in vol. xxxi, pp. 65 and 151 and vol. xxxii, p. 408. There is also an article in vol. xxxii, p. 170, and there are several prior to all these mentioned. A perusal of these articles will give one a good idea of the opinions prevailing on this subject and of the reasons therefor.

Books on Roads and Sewerage.

I would like to obtain some information on books treating the construction of roads and pavements. I want books that treat the subject in a practical way. I would like to know if Aitken's book would be suitable for the practical construction of roads in the United States. I would also like to know if Staley and Pierson's book on sewerage is a practical book on sewer work and what it treats of in details.

D. J. O., San Francisco, Cal.

Aitken's "Road Making and Maintenance," ($6.00) is a good book which is applicable in the United States, except so far as it discusses English materials for roads. Probably the latest edition of Byrne's "Highway Construction," ($5.00), is the best American book on macadam roads, although Baker's "Roads and Pavements," ($5.00), is also good and devotes much space also to brick, asphalt, wood and other hard pavements..

Staley and Pierson's "Separate System of Sewerage" ($3.00) is a very practical book, written by practical men, and gives methods of construction mainly of pipe sewers, because the book is restricted to sanitary sewers and it does not consider the larger sizes in other materials which are necessary for combined systems.

Estimates of Sewer Excavation.

What have you on estimating sewer excavating, all depths and classes of material?

J. P. D., Trinidad, Colo.

On page 97 of the February number will be found a list of articles in MUNICIPAL ENGINEERING on this subject which are the most detailed of a large number of similar articles. Folwell's "Sewerage" ($3); Kirchoffer's "Diagram for Estimates of Pipe Sewers" (25 cents), without reference to depth; Staley and Pierson's "Separate System of Sewerage" ($3), with reference to cost of sheet piling, give some instruction, but not so much as the articles above referred to.

Licensing of Dogs.

Knowing that you are generally informed on all subjects pertaining to the welfare of municipalities, it occurred to the writer that you could furnish some reliable information upon the subject of dog regulation in cities and towns, hence I appeal to the question department of your valuable magazine. What city in your opinion has the most practical and satisfactory legislation for the regulation of the canine population? Is it customary in

eastern cities to license dogs and permit them to run at large?

C. W. SWEARINGEN,
City Engineer, Great Falls, Mont.

In vol. xxx, p. 350, of MUNICIPAL ENGINEERING are skeletons of the ordinances regulating the keeping of dogs, which are in force in Kansas City and in Cincinnati, and some discussion of them. It is there stated that neither is entirely satisfactory but that the Kansas City ordinance is considered the better. It follows the usual custom of licensing dogs and then applying to the licensed dogs such further regulations as seem to be necessary at particular seasons and for particular classes of dogs, those not wearing a license tag being subject at any time to capture for the dog pound and disposal if not claimed and fees and fines paid, or to death at sight at times of distrust.

List of Engineers in United States.

I am desirous of obtaining a list of the engineers of the principal cities of the United States.

J. S., Albion, N. Y.

The best list of engineers in print is that in the "Directory of American Cement Industries" ($5). While it is confined to those interested in the use of cement, this restriction is practically of little effect because so large a proportion of practicing engineers is engaged in work in which more or less cement is used. The city engineers are designated in the list.

FROM WORKERS IN THE FIELD

Practical Points from Practical People.

Contributions to this Department are invited. Give from your experience for the benefit of others. No matter about the style of the composition, the fact is what is wanted. Use the Question Department for what you want to know; use this Department for what you can tell others.

A Unique Sewer Cleaner.

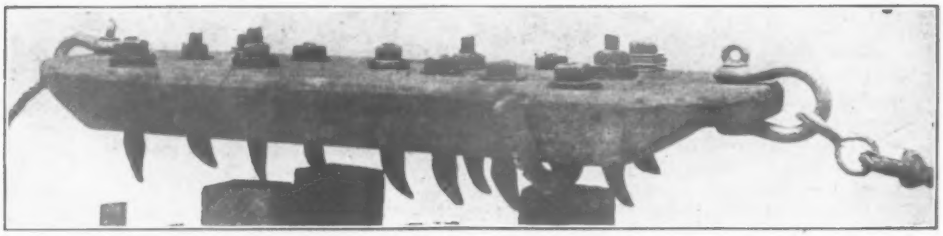
Editor of MUNICIPAL ENGINEERING:

Sir: Thinking that some of the readers of MUNICIPAL ENGINEERING might be interested in a difficult sewer cleaning proposition, I am inclosing a picture of an apparatus I had constructed and used successfully in cleaning an 18-inch tile pipe sewer, which had resisted, for years, efforts made to clean it with every known device, including two patented sewer cleaning machines.

The sewer in question had a hard deposit in it, from four to ten inches in depth, composed of gravel, tar, lint and pieces of metal. The latter was largely pins, buttons, buckles and other pieces of metal such as might be found among old clothes. As the metal was all in small thin pieces, it was thought that it and most of the other foreign matter came from the beaters and washing vats in a paper mill plant located on one side of the street occupied by the sewer. This deposit was so solidly cemented together that, where it could be gotten at in the manholes, not the slightest impression could be made on it with a shovel, and with a pick considerable force had to be used to break it up.

There were four manholes to this sewer within a distance of 700 feet, which made them about 200 feet apart along that portion holding the deposit.

The tool shown in the picture consists of a casting 3x15x35 inches and weighs 400 pounds when ready for service. It has twelve soft steel teeth, ranging in length or extending below the bottom of the casting one and one-half to three inches. The tool was placed in the sewer at the manhole nearest the outlet and drawn forward and back between manholes by means of small wire cables, one attached to



A SEWER CLEANER FOR SPECIAL WORK.
B. E. Briggs, City Engineer, Erie, Pa., Designer.

each end of the tool, passed through a block in the bottom of the manholes, and around the drum of a winch set over each manhole. This operation was continued until the deposit was torn up and all washed out into a creek about 200 feet beyond the first manhole. The washing out was accomplished by turning two lines of fire hose into the sewer above the deposit.

B. E. BRIGGS,
City Engineer, Erie, Pa.

How to Hasten Setting of Cement in Cold Weather.

Editor of MUNICIPAL ENGINEERING:

Sir: I noticed in your question department, February issue, that P. L. Cherry Co., Portland, Oregon, wanted to know if there was some chemical that would make cement set quicker in cold weather. I use calcium chloride in solution varying from 20 to 50 per cent., according to what is needed. This not only hastens the set, but prevents freezing at ordinary temperatures without injury to the appearance or strength of the concrete, except in possibly the stronger solutions.

G. G. RIGGS, Waterbury, Conn.

MUNICIPAL ENGINEERING would like to have other reports of the practice of its readers regarding treatment of concrete and mortar laid in cold weather, and their observations regarding the action of calcium chloride and other chemicals.

Wide Tires.

Editor of MUNICIPAL ENGINEERING:

Sir: You say in comment on my letter in your January issue: "This (the fact that the more severe conditions in cities, both as to the disturbance of foundations and wearing surface, and as to traffic, make concrete foundation desirable if not necessary) does not reduce the force of Mr. Heiskell's arguments regarding wide tires for roads." Yes, and it does not reduce their force as to city streets.

That was just my point. Wide tires would vastly lessen the severity of those conditions, and so put off forever the evil day of stone block. Would you say, let all streets be fitted with concrete foundations right up to the city limits and let the joy of narrow tires be unconfined by any limits? And, then, if you do say that, don't you know that the present narrow tires make traffic much "heavier" than would properly wide ones, and so require more expensive foundations and much more of the brick or asphalt covering? Hear Judson on that point. point.

"These great loads, formerly carried upon narrow tires, speedily cut furrows in the hard stones (Catskill blue-stone) so that the slabs, 6 to 8 inches thick, were cut through in three or four years. Wide tires are (now) used on all wagons carrying these loads, so that 4-inch slabs of blue-stone are now used for renewals of the wheel tracks." Both the foundation and the wearing surface almost halved by only about double-tire width.

Don't you know the fact that a doubled load, a halved-tire width, a doubled crushing pressure, or a fourfold depth of cut, or somewhere between the two evils, may mean five or even ten times the destruction? Hear F. A. Kummer on that: MUNICIPAL ENGINEERING, November, 1906); "If the traffic (heaviness) does not reach the limit of durability (stability) of the material, the pavement will last almost indefinitely, because the character of the traffic (narrow-tire intensity of crushing pressure) is not sufficiently heavy to destroy it, but if this traffic in character as well as amount passes the limit of durability (crushing strength) of the pavement, the pavement will be destroyed in a comparatively short time."

Can't you see any street problem about reduction of the vast destruction of the immense mileage of macadam in cities today? Why is so much said about macadam in cities if the trouble from narrow tires is confined to macadam on country roads, where tires are already relatively wider?

Why can't you see; why won't you see, that we couldn't have wide tires in the country and not in the city, without two standards, and that country people think cities should have the wide tires?

Why won't you see that the natural law is in absolute control of the situation in cities as well as in country districts; that mechanics is no respecter of city limits; that we must pay for every infringement of nature's laws irrespective of our place of birth or place of residence at the time of the experiment?

I know perfectly well that the wide tire is unpopular, but it is vastly better than popular; it is absolutely necessary if we are ever to have anything but roads and streets made bad from choice and at an awful expense in the process of worse than needless destruction.

Galileo's contention was most unpopular, but the advocacy of the Aristotelian system did not change the face of the earth one particle, whereas the practice and advocacy of narrow tires has changed greatly the whole surface of the earth, and most disastrously that very large surface which touches most frequently and closely the life of the United States, the street and road surface.

I appeal to you to drop all semblance of opposition and help me to bring about a revolution in regard to our streets, seeing that the best street must be that which is best under the best use, only. The law and the evidence tell us that narrow tires are much worse for streets, vehicles and horses. He who is not for us is against us.

J. M. HEISKELL,
Memphis, Tenn.

Comment on the letter is not necessary for those who have read the articles referred to and others preceding, and have therefore recognized that this magazine favors anything that will improve the roads, and that it makes no difference between roads of the same materials in city and country. Concentration of traffic on some city streets demands more durable foundations and surface materials than do country roads, but some city streets are practically under the same conditions as country roads as to traffic, and the wide tires will aid them all, country and city roads and pavements. Conditions of travel are changing by the introduction of the automobile, and, notwithstanding the exaggerated width of automobile tires, they are introducing a new destructive force upon the roads. Those roads which are subject to fast automobile travel must shortly receive more heroic treatment than simple macadamizing, and road surfaces intermediate between macadam and city pavements are developing and will be applied in rapidly increasing ratio in the future. These new surfaces will be affected more injuriously than pavements are by ordinary wagon wheels, and there will therefore arise a new demand for wide tire legislation.

Electric Drive in a Modern Cement Mill.

This article, while intended to give a thorough description of details of construction, equipment and operation of the new and modern plant of the Kansas City Portland Cement Company, will not enter into the details of cement manufacture. This phase of the question has been dealt with thoroughly in previous technical issues.

The plant of the Kansas City Portland Cement Company is located eleven miles northeast of Kansas City, and is situated on the Missouri River bluffs overlooking the river and valley.

The quarries from which are obtained the raw materials are located 200 feet above the river, extend a mile either side of the crusher building, and are served by an industrial railway equipped with automatic side dump cars and a 20-ton oil-burning locomotive. The main track of the industrial railway passes directly through the head house of the crusher building and the cars are automatically dumped directly into the hoppers of the crushers. The limestone crusher is driven direct by a 100 horse-power constant speed induction motor. The shale pulverizer is driven direct by a 30 horse-power constant speed induction motor. The starting and protecting devices are located adjacent to each motor and each motor is therefore individually and independently controlled and protected, and always under the eye of the operator when starting or stopping.

The materials from the crusher and pulverizer are discharged directly into individual rotary dryers, each 6 feet

in diameter by 60 feet in length, and the drying process is accomplished by combustion of fuel oil within the dryers. For economical operation it is necessary that both dryers be in operation at the same time and they are therefore driven collectively by a 30 horse-power constant speed induction motor.

The dryers discharge into individual storage bins, each having a capacity sufficient for three days' operation.

Working in connection with these storage bins is an automatic hopper scale charging car, operated by a power haul, which automatically receives and mixes materials from each of the bins. After being mixed thoroughly and in the proper proportions, the material is automatically dumped into a gravity chute and delivered to the raw mill, some forty feet below this point of operation.

The raw mill is equipped with large steel bins, which receive the raw material from the gravity chute. The bins are arranged to discharge automatically the raw material directly into hammer mills, where the process of pulverizing and mixing is carried to a further degree. The hammer mills discharge directly into a bin equipped with a conveyor, which automatically elevates and discharges the pulverized material into bins located in an advantageous position for feeding the tube mills.

The raw material passes from the last named bins to tube mills, 5 feet in diameter by 22 feet in length, where it is further pulverized, mixed and prepared for entrance to the kilns. The raw material is carried and fed to the upper end of the kilns by a screw conveyor.

The plant is equipped with four rotary kilns, each 8 feet in diameter by 125 feet in length, each having a capacity of from 500 to 750 barrels per day. Each kiln is driven directly by a variable speed induction motor, with a speed range from maximum to 50 per cent. at constant torque. The motors and drive are located approximately midway of each kiln, while the controllers and protective apparatus are located directly in front of each kiln, thereby simplifying at a glance, for the operator, the relation of speed to feed and temperature.

KILN ROOM OF PORTLAND CEMENT PLANT.
Freeborn Engineering Co., Designers.

These kilns are unique in the fact that they are the largest rotary steel shell kilns in operation and contain many features pertaining to drive and method of burning clinker. They were especially designed, constructed and erected under special supervision of the engineers for the plant, and have proven in operation a great deal more than was guaranteed or expected of them.

The kilns discharge the clinker at the lower end into a pit equipped with a bucket elevator, which handles and discharges the clinker directly into 6 by 60 feet rotary coolers. The coolers are each driven by constant speed induction motors.

The clinker, after passing through the coolers, is transported by an industrial tramway to either the clinker storage bin or directly to the finishing mill, where it is discharged into large steel hopper bins. The hopper bins feed directly into the Griffin mills, where the preliminary grinding is accomplished and the product discharged into a pit equipped with a conveyor which transports the material to bins located so as to feed advantageously the finishing tube mills. The final grinding and mixing is accomplished by tube mills, each 5 feet in diameter by 22 feet in length. These mills discharge directly into a conveyor, which transports the finished material to the stock house, where it is stored ready for sacking and shipment.

The stock house is equipped with portable automatic weighing and sacking machines, each driven by a constant speed induction motor. Between the stock house and main mill is located a modern machine shop, thoroughly equipped with tools to make all necessary repairs for the entire mill. A portion of the shop equipment consists of a traveling crane, steam hammer, lathes, shapers, boring mill, pipe machine, keysetting machine, planers, grinding machinery, etc. The entire shop is driven by a constant speed induction motor.

The power plant is located in the center of the main mill building and is divided into sections, each section driving half of the mill.

The boiler room equipment consists of a battery of water tube boilers equipped with economizers and oil burning apparatus.

The engine room equipment consists of two 1000 horse-power cross compound condensing Corliss engines, transmitting power by two rope drives; two tandem compound, four valve engines, direct connected to two 200 k. w. 440-volt, 3-phase, 60-cycle, revolving-field, alternating current generators, one 200 k. w., 440-volt, 3-phase, 60-cycle, r. f. belt-driven, a. c. generator, and auxiliary apparatus, such as surface condensers, exciters, switchboard, etc.

The water for condenser and boiler feed purposes is obtained from the Missouri river by means of three single-stage turbine pumps, direct connected to three constant speed induction motors.

The reinforced concrete pumphouse is located on the river bank some two hundred feet from the power house, and the water is transported by means of a special pipe laid in an accessible tunnel.

Those portions of the plant subjected to extremely severe service are equipped in duplicate and a breakdown in any one of these departments will not discontinue or handicap operation. To insure further against operating interruptions the steel bins supplying material to all grinding machinery are of sufficient capacity to supply the mill for twelve hours. The reinforced concrete clinker storage bins are of sufficient capacity for 5,000 barrels. The reinforced concrete cement storage room has a capacity for 50,000 barrels of finished product.

The entire plant is of the most modern fireproof construction, and this, together with the arrangement and design of equipment, gives and leaves the pleasing impression of simple yet artistic design, solidity of construction and simplified operation.

The mill was placed in operation some five months ago, and has far exceeded the guarantees of the engineers and the expectations of the owners in the quality and quantity of product and low cost of operation. The entire plant was designed and constructed by the well-known Freeborn Engineering and Construction Company, of Kansas City, Mo.

A. BICKEL, Kansas City, Mo.

PROBLEMS OF ADMINISTRATION

Business Administration—Municipal Ownership in Chatham—Oklahoma Coal and Asphalt—Ohio Bridge Trust—New York Public Service Commission—Des Moines Plan—Niagara Power—Supervision of Accounts.

Business Administration Forms Demanded for American Cities.

In an address on the subject of municipal problems before the Taxpayers' Association at Paterson, N. J., February 11, Vice-Chancellor Eugene Stevenson said in part:

Charters were formerly framed as though cities were little states. Americans are only now learning, after many years of bitter experience, that they are not so much little states as large corporations. Many of the mistakes which have marked the progress of American cities up to this point have sprung from that defective conception. The aim deliberately was to make a city government where no officer by himself should have power to do much harm. The natural result of this was to create a situation where no officer had power to do much good.

Meanwhile bad men united for corrupt purposes and the whole organization of the city government aided such in throwing responsibility from one to another. Many recent city charters in the United States proceed on the more accurate theory that cities, in their organic capacity are chiefly large corporations.

If we are going to have a good government, what is the practical conclusion? Under existing conditions the best system for the business of the citizens of this city is the commission system. The theory which underlies this system is not a petty state, nor should politics enter into the government.

Municipal Ownership in Chatham, N. J.

Municipal ownership of the water and light plants of Chatham, N. J., is a success, according to the annual report of the board of water and light commissioners. The total net profit to the town from the two plants for the last year was $2,664.45. This takes into consideration, as a receipt, charges for maintenance of 127 street lamps and two arc lamps, amounting to $2,466, and of fire hydrant service, amounting to $2,025. These figures are based on the same charges that a private corporation would make for the service. The report shows that four years ago there were 84 consumers of light, and 201 of water. Now there are 150 consumers of light and 267 users of water. The inventory shows the plant assets, at the present price of labor, apparatus and materials, to be $90,748, the entire debt $60,815, thus leaving a balance to the borough's credit of $30,933.

Oklahoma Wants to Buy Coal and Asphalt Lands.

The commission authorized to inquire into the extent and value of the segregated coal and asphalt lands belonging to the Choctaw and Chickasaw nations, looking towards their purchase by the state, is about ready to submit its report to the legislature of Oklahoma. The commission is said to have reached the conclusion that at this time there is no means at hand to ascertain the reasonable value of the lands, but that under no circumstances a price in excess of $10,000,000 will be considered by the state. The state's purpose in proposing to buy the lands is to gain state control of its coal and asphalt resources.

Ohio Bridge Trust Indictments Defective.

The Ohio supreme court handed down a decision February 11, holding that the indictments brought against the bridge trust in Ohio and charging violation of the anti-trust laws, are defective. The indictments were brought in Erie county in the circuit court. They are held to be illegal on the grounds of duplicity and indefiniteness, in that they simply charge that the parties were engaged in a conspiracy in restraint of trade from March, 1903,

to March, 1906, without stating definite times of violation of the anti-trust laws, and because the laws make each a separate offense, and hence the basis of a separate indictment. On a charge of engaging in a trust conspiracy from March 10, 1903, to March 9, 1906, the King Bridge, Massillon Bridge, Bellefontaine Bridge & Iron, Variety Iron Works, and Mt. Vernon Bridge companies, of Columbus, Brackett Bridge and Canton Bridge companies, of Canton, were indicted last March in Erie county. The common pleas court overruled all motions to quash all demurrers based on duplicity and indefiniteness of the indictments and all the defendants were convicted. The cases were carried to the circuit court, and later three of the companies withdrew their petitions in error and paid the fines imposed. The case was then taken to the circuit court which reversed the convictions in the common pleas courts. It was then carried to the supreme court, with the above result.

The New York Public Service Commission Sustained.

The court of appeals, at Albany, New York, declared unconstitutional, February 18, the law of 1905 creating the former state commission of gas and electricity, because it fails to provide for appeal. The court, however, upholds the authority of the legislature to delegate to a subordinate body the power to regulate the prices to be charged for gas and electricity by public service corporations. It holds, however, that a company has the right of appeal to the commission at any subsequent date. The decision is regarded as sustaining by inference the underlying principle of the act of last year creating the public service commission in place of commissions of gas and electricity and railroads.

Power from Niagara Below the Falls.

A hearing concerning the utilization of the power of Niagara River was given, February 17, before the Rivers and Harbors Committee of the House. A bill was introduced recently by representative Alexander, of New York, providing that the Niagara Power, Water and Supply Company be allowed to divert water from points not less than a mile below the falls. A wide divergence of views was brought out in the discussion following the hearing, as to whether or not the use of water power from the river for industrial and commercial purposes will interfere with the beauty of the river or in any way produce injurious effects.

The Des Moines Plan is Constitutional.

An opinion regarding the constitutionality of the Des Moines plan of municipal government by the commission, and upholding the law in every particular, was handed down, February 18, by the Iowa supreme court. The court holds that it is within the province of the legislature to provide for commission plans in Iowa city governments.

State Supervision of Public Accounts in Michigan.

The Michigan Constitutional Convention which has just concluded its labors in framing a new state constitution has included therein a section for state supervision of all public accounts in the state, and which if adopted will unquestionably be of great value by the way of improved and better observance of the law in connection with public moneys. The section is as follows:

The Legislature shall provide by law for the keeping of accounts by all state officials, boards and institutions, and by the officials of all municipal corporations; and shall also provide for the supervision and audit thereof by competent state authority and for uniform reports of all public accounts to such authority. Such systems of accounts shall provide for accurate records of all financial and other transactions and for checks upon all receipts and disbursements of all such officials, boards and institutions; and shall be uniform for all similar boards, institutions and municipalities. All public accounts and the audit thereof shall be public records and open to inspection.

Pollution of Lake Michigan Becoming Serious.

At a recent meeting of the board of health and physicians of Michigan City, Ind., Dr. W. A. Evans, health commissioner of Chicago, declared that the whole bottom of Lake Michigan, at its southern end, would soon be one vast culture bed of typhoid fever and other enteric diseases if the cities and towns along the shore continued to pour sewerage into the lake as they are now doing. A mass convention will be held

March 1 by the health officers and other interested persons of all the cities and towns along the lake between Chicago and Michigan City, with the state boards of health of Illinois and Indiana, for the purpose of discussing the problem. The choice of meeting place was left for Dr. Evans to name.

Portland Cement Production in 1907.

The Portland cement producers of the United States have replied so promptly to the statistical inquiries addressed to them by the United States Geological Survey that it is now possible to make a very close estimate of the Portland cement production for the calendar year 1907. Mr. Edwin C. Eckel, who is in charge of the statistical work on cement for the Survey, has accordingly prepared the following statement:

Returns have been received from 87 plants, representing over 95 per cent. of the Portland cement production of the United States. As the ten plants which have not yet replied include only two large producers, it is possible to make a fairly accurate estimate of the total cement production of 1907. The returns so far received indicate that the total output of Portland cement in the United States during the calendar year 1907 was approximately 48,000,000 barrels. This should be compared with an output of 46,463,424 barrels in 1906, and of 35,246,812 barrels in 1905.

Though the production of 1907 shows an increase over that of 1906, it is slight as compared with past annual gains in the cement industry, indicating that the Portland cement production of the United States has now reached a stage in its development where it is directly and promptly affected by general business depression.

An official statement that the cement required for the Panama Canal would be only 4,500,000 barrels has served to put at rest exaggerated ideas concerning the importance of this work to the cement trade. The further statements that bids would be asked for delivery of clinker on the isthmus, and that the Government might possibly erect its own cement plant there, are also of interest to existing American plants.

Imports during the year were 2,111,819 barrels and exports were 900,550 barrels so that the total consumption of Portland cement in this country in 1907 was slightly more than 49,000,000 barrels.

Graft in St. Joseph Electric Lighting Plant.

The management of the municipal electric lighting plant at St. Joseph, Mo., was severely criticized in a report by the grand jury recently, which in part said:

We have investigated the municipal lighting plant of the city of St. Joseph and we believe that the city of St. Joseph has been defrauded out of thousands of dollars by padded payrolls and the disposal of junk and other salvage by the employes. This has been made possible by the inefficient supervision and management of the plant and appurtenances thereto belonging.

Conditions in this department of the city government, as shown by a thorough investigation, are much worse than any grand juror expected and when the matter was first called to our notice. The sale of "time slips" for more than the amount earned by the man; the carrying of "dead" men on the payrolls and the sale of city property without authority from the proper sources, are particularly reprehensible.

Public Work in Indianapolis.

The annual report of the city engineer's department, at Indianapolis, Indiana, shows that public improvements were completed during 1907 to the total value of $1,415,659.97. This is exclusive of new work and repairs to bridges, done under the direction of the street commissioner's office, amounting to $6,275. A table showing the kind and amount of work done during 1907 and the cost of each, is as follows:

	Miles.	Cost.
Asphalt	8.75	$ 283,762.80
Brick	10.36	280,446.22
Bitulithic	4.59	163,931.13
Bitulithic resurface	.73	20,552.20
Wooden block	.72	28,695.76
Macadam	2.41	40,655.16
Gravel streets and alleys	7.00	130,689.53
Graded streets and alleys	5.67	77,085.00
Cement walks	30.63	184,362.92
Sewers	16.71	205,479.25
Total cost		$1,415,659.97

Ohio Municipalities Cannot Do Commercial Lighting.

The supreme court of Ohio has rendered a decision holding that municipalities in Ohio have no right to furnish electric light to private consumers. In the course of a suit brought by Robert H. Jackson against the municipality of Nelsonville it developed that in framing the new municipal code the legislature repealed the old law giving the right to cities to

furnish electric light and power to private consumers, vesting them only with the power to own and operate water and natural gas plants for the consumption of the inhabitants. The right to operate electric light plants for other than strictly municipal uses, such as for furnishing power to swing bridges, lights for city buildings, etc., was withdrawn. The suit was regarded particularly as a blow against the municipal ownership projects of Tom L. Johnson, some of which he has put into effect, notably in the case of the South Brooklyn municipal lighting plant, which he has been extending at much cost to the taxpayers.

ORGANIZATIONS AND INDIVIDUALS

N. A. C. U.—Technical Meetings—Civil Service Examination—W. F. M. Goss—J. Walter Ackerman—Personal Notes.

National Association of Cement Users.

The convention of the National Association of Cement Users was in progress at Buffalo as the February number of MUNICIPAL ENGINEERING was on press. Several of the papers presented were printed in the January and February numbers and others will be found in this and subsequent numbers. Several names on the "tentative" program were apparently put on without authority but several excellent papers were presented.

Prof. W. K. Hatt gave a short talk on the elementary mechanics of reinforced concrete. W. H. Mason gave the paper printed last month in this magazine on construction of buildings with separately molded members and E. G. Perrot the one on systems of reinforced concrete. M. Wetzstein presented the report of the committee on machinery for cement users and C. D. Watson that of the committee on art and architecture.

R. W. Lesley gave a talk on co-operation. Architect E. B. Green discussed the artistic treatment of reinforced concrete. Albert Moyer gave the paper on exposed selected aggregates in monolithic concrete construction which appeared in the January number of MUNICIPAL ENGINEERING. Charles D. Watson described and illustrated factory made concrete. The report on streets, sidewalks and floors by the chairman of the committee, G. L. Stanley, and the paper on the same subject by C. W. Boynton made some definite recommendations of specifications. E. P. Goodrich discussed the necessity of continuity in the steel reinforcement of concrete structures. Willis Pierson told about making money making blocks and H. C. Henley about regulation of concrete construction in papers published in this magazine. Mr. Fox showed by pictures and drawings how to handle concrete. There were several other papers on various details.

The exhibit was even larger than at former conventions but the number of visitors from Buffalo and vicinity was not nearly so large as Chicago and vicinity supplied last year or as attended the Chicago show in December. The list of members registered seemed to be smaller also, although comparison was difficult on account of the confusion in the Chicago registry last year. There seem to have been about 230 members present aside from exhibitors. Of the latter some 60 or 70 registered. The exhibitors, classified according to their most prominent feature included approximately one sand company, two sewer molds, nine systems of reinforcement, fourteen mixers, seven waterproofing methods, thirteen cement companies, forty-five chines and processes and fifteen miscellaneous kinds of apparatus and supplies for cement makers and users.

The east apparently is not so interested in the uses of concrete represented at the convention as the west, and this was recognized by the proposition to hold two conventions in the west before another is placed in the

east. The exhibit feature has each year been allowed and encouraged to take a more important position in the convention and indications are becoming still stronger that the association must put itself on the commercial basis entirely. This will be accomplished by the proposed method of paying the supposably permanent secretary mainly out of the proceeds of assessment upon the exhibitors. The Chicago show is upon the commercial basis wholly and was an unqualified success. There is room for two exhibits. The one in Chicago promises to be an annual affair. The Association's exhibit can scarcely go back to Chicago without interfering with both, unless a combination is effected. There is no other place equal in advantages to Chicago for holding a permanent exhibit and a traveling exhibit is subject to the ups and downs of varying circumstances. It must therefore content itself with taking second place.

There was but little change in the list of officers.

Technical Associations and Meetings.

The New York offices of Underwriters' Laboratories, Inc., have been moved from 29 West 39th street to 12th floor of the building 135 William street, where the offices of the National Board of Fire Underwriters are also located. Mr. George E. Bruen, employed in an engineering capacity by the National Board, will take up the laboratory work in connection with his other duties, and has been appointed engineer for Underwriters' Laboratories, Inc., to have charge of the business of that corporation in and around New York City. W. H. Morrill is the manager.

The twenty-ninth annual meeting of the Ohio Engineering Society was held at Columbus, Ohio, February 11, 12 and 13. Among the papers submitted were the following: "Sewers and Sewer Methods," by W. H. W. Jenkins; "Reinforced Concrete Bridges," F. A. Bone; "Cement Sidewalk Construction," L. A. Keith; "Something on Land Drainage," H. C. White; "Notes on Lining a Broken Reservoir with Reinforced Concrete," Wm. Wilson; "Some Lessons from a Cofferdam," W. H. Boughton; "Approximate Estimates," Alexander Potter, New York City, printed elsewhere in this number of MUNICIPAL ENGINEERING; "Specifications and Their Interpretation," E. G. Bradbury, Columbus, O.; "City Wastes and Street Cleaning," Paul Hanson; "The Development of the Mechanical Filter Plant," Philip Burgess.

The twenty-fourth annual meeting of the Connecticut Society of Civil Engineers was held at New Haven, Conn., February 11 and 12. Among the papers presented were the following: "The Purification of Water by Sand Filtration," by William B. Fuller; "Reinforced Concrete Bridges," M. W. Denman; "The Harbor and Rivers of New Haven," J. F. Jackson; "Stream Flow Data, with Reference to Water Power in Connecticut and Vicinity," C. E. Chandler; "Mill Rock Water Tower at New Haven, Conn.," E. E. Minor; "Water Waste Investigations," W. E. Johnson and E. E. Peck; "The State Boundary Survey," H. P. Buck; "Hydraulic Fill Dams," W. S. Morton.

The twenty-seventh annual meeting of the Engineers' Society of Western Pennsylvania was held January 21 in the society's rooms in the Fulton Building. Newly elected officers were installed as follows: President, J. K. Lyon; vice-president, E. K. Morse; treasurer, Prof. A. D. Frost; directors, S. P. Grace and H. W. Craver.

At the regular annual meeting of the Montana Society of Engineers, held in the rooms of the Gallatin Valley Commercial Club, Bozeman, Mont., officers were elected as follows: President, Archer E. Wheeler, superintendent of Boston & Montana Reduction Works, Great Falls, Mont.; 1st vice-president, Charles H. Bowman, president Montana State School of Mines; 2d vice-president, Frank M. Smith, mining engineer, East Helena; secretary, Clinton H. Moore, Butte; treasurer, Samuel Barker, Jr., civil and mining engineer, Butte. A resolution was passed placing the society on record as favoring the McKinley engineering experiment station bill, lately introduced in Congress, which provides for the establishment of engineering experiment stations at all land grant colleges.

The annual meeting of the American Water-Works Association will be held at Washington, D. C., May 1 and 2. John M. Diven, 14 George St., Charleston, S. C., sec'y.

The annual convention of the American Society of Civil Engineers will be held at Denver, Colo., June 23, 24, 25 and 26. C. W. Hunt, sec'y., 220 W. 57th st., New York City.

The annual convention of the American Society of Mechanical Engineers will be held at Detroit, Mich., June 23, 24, 25 and 26. C. W. Rice, sec'y., 29 W. 39th st., New York City.

The Society of Engineers and Architects of Cuba has been formed with

Aurelio Sandoval as president and Luis Garcia Nattes as secretary, with offices at Mercaderes 2, Havana, Cuba.

On February 21 the Ohio Association of Contractors was formed in Columbus. The roster of the new organization is composed of the largest and most enterprising of contractors from various portions of the state. The object of the organization will be for mutual benefit, exchange of business ideas and the general good of contractors. The following officers were chosen: President, Col. N. B. Abbott, Columbus; vice-president, F. H. Kirchner, Cincinnati; secretary-treasurer, George B. McGrath, Cleveland; board of trustees, James E. Conley, Dayton; Edward Kelly, Portsmouth; William J. Wildes, Akron; Philip Garrigan, Toledo; Oliver Reilley, Cleveland; L. A. Fauver, Elyria; Thomas J. Mulligan, Lima; William M. Graham, Columbus; William H. Adams, Zanesville.

The officers of the Association of Licensed Cement Manufacturers, the formation and membership of which were reported last month are President, A. F. Gerstell, vice-president and general manager of Alpha Portland Cement Co.; vice-president, Conrad Miller, president of Dexter Portland Cement Co.; secretary and general manager, Alfonso De Navarro, vice-president of Atlas Portland Cement Co.

The Independent Asphalt Association, 90 West street, New York City, as a result of its discussion of the subject, has issued a pamphlet entitled "The Control of Street Openings," which shows the defects of practice in New York and other cities and gives the opinions of many city engineers in all parts of the country concerning the best method of preventing the enormous damage now done to pavements and recommends working toward conduits or subways for all pipes and wires. The pamphlet will be sent to city engineers and other municipal authorities on request. The officers of the association are president, Walter V. Cranford, Brooklyn, vice-presidents, P. R. Quinlan, Syracuse, and F. H. Kirchner, Cincinnati, secretary, P. W. Henry, and treasurer, Hugo Reid, both of New York.

The Association of Ontario Land Surveyors held its fifteenth annual meeting Feb. 25, 26 and 27 in Toronto.

At the meeting of the Municipal Engineers of the city of New York, held Feb. 26, Mr. W. B. Fuller presented an illustrated paper on "The Proposed Filtration of the Croton Water Supply of New York City."

The report of the fourteenth annual convention of the American Society of Municipal Improvements has been issued and contains the usual amount of valuable information about methods and results of municipal improvement activities. It can be obtained for $1 from the secretary, 512 Flatiron Building, New York City.

The Canadian Society of Civil Engineers will hold a business meeting March 12 at its rooms in Montreal. The electrical section meets March 5 and the mechanical section March 19.

The first International Road Congress will be held in Paris in November, 1908, under the patronage of the Minister of the Interior and of Public Works in France to discuss methods of adaptation of roads to modern traffic.

At the meeting of the New England Water Works Association held Feb. 12, papers on the new filter at Lawrence, Mass., were read by Morris Knowles, M. F. Collins and Arthur D. Marble, and a report on the collapse of the filter roof during construction, which will be found elsewhere in this number of MUNICIPAL ENGINEERING, was read by Sanford E. Thompson.

U. S. Civil Service Examinations.

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

March 4 for apprentice draftsman in the office of the Chief of Ordnance, War Department at $360 a year with promotion to $60 a month and more on additional examination; aid in Bureau of Standards, Department of Commerce and Labor, at $600 to $720 a year; supervising engineer of road construction for 6 months from January 1 in Chickamauga and Chattanooga and National Park at $125 a month; assistant geologist, qualified in petrology in Geological Survey at $75 a month with promotion to assistant geologist and geologic aid at $1,000 to $1,600, also appointments as temporary field assistants at $60 to $100 a month for 3 to 7 months, and on per diem basis for part time.

March 25 for draftsman, qualified in engineering construction and supervision of plumbing installation in Immigration Service, Ellis Island, at $6 a day for time actually employed.

March 29 for superintendent of road construction at $4 to $7 a day in office

of Public Roads, Department of Agriculture.

April 15 and 16 for junior engineer at $720 and upward and assistant engineer at $1,500 a year and upward in the Reclamation Service.

May 6 for apprentice in the Mint and Assay Service at Philadelphia, New Orleans, Denver and San Francisco at $3.50 a day first year, $4 second year and $4.50 third year.

J. Walter Ackerman.

Mr. J. Walter Ackerman, who has been until recently the city engineer of Auburn, N. Y., is an American to the eighth generation, that ancestor coming from Holland early enough to admit Mr. Ackerman to the Holland

J. WALTER ACKERMAN, AUBURN, N. Y.

Society of New York. Indeed all Mr. Ackerman's ancestors are of Dutch descent except a slight admixture of French Huguenot.

Mr. Ackerman himself was a farmer's son who obtained his education in central New York including his college education at Cornell University, taking some years for it because he earned the money to pay for it as he went along.

His first engineering work was upon cross-country trolley line construction, but two or three years after entering the profession regularly he opened an office in general engineering practice in Auburn, N. Y., which developed largely into sanitary work. He was appointed city engineer of Auburn in January, 1902, and continued as such for six years. Auburn is a city of 40,000 inhabitants and during Mr. Ackerman's official connection with it a system of sewers and disposal works has been designed, with the aid of Geo. S. Pierson, of Kalamazoo, Mich., to cost about $150,000. Work on this system will soon be commenced.

The annual expenditures of the city for municipal improvements have been from $75,000 to $100,000. Among the features of interest in this work are the successful change of street railroad rail from the Johnson girder rail to the standard 90-pound T-rail, and the laying of brick pavement adjacent thereto. This new construction seems to give excellent results both to street service and in maintenance.

Another work somewhat outside the usual line was the construction of a municipal conduit system to carry all the public service wires in the central part of the city. Mr. Ackerman described the construction of this system in an article published in MUNICIPAL ENGINEERING for December, 1907. Information on this subject is difficult to find and the article as well as Mr. Ackerman himself will be referred to frequently.

Much was done by Mr. Ackerman toward making an accurate survey of the city, marking street lines and establishing and defining the city's rights, not always easy in the cities of the eastern states.

Since leaving the office of city engineer, Mr. Ackerman has continued his work as a consulting municipal engineer, specializing on municipal underground electrical conduit systems. He is reconstructing the traction system of Ithaca and completing the interurban line between Ithaca and Auburn.

He is a member of the American Society of Civil Engineers and of the American Society of Municipal Improvements.

Inauguration of Dean W. F. M. Goss.

Prof. W. F. M. Goss was installed as dean of the college of enginering of the University of Illinois on the morning of February 5, at one of the sessions of the exercises comprising the formal opening of the graduate school of the University. Addresses upon the graduate school, the graduate student, university research, the engineering school and its graduates, in various phases were made by Pres. G. Stanley Hall, of Clark University, Dean Andrew F. West, of Princeton Univer-

sity, Prof. C. H. Moore, of Harvard University, Prof. I. O. Baker, Prof. W. A. Noyes, Prof. C. N. Greenough and Dean David McKinley of the graduate school, W. L. Abbott, president of the board of trustees of the University of Illinois, Pres. C. H. Kammelkamp, of Illinois College, Pres. Thos. McClelland, of Knox College, Robert W. Hunt and W. A. Smith, of Chicago, and Prof. W. F. M. Goss, whose address was upon the subject of the State College of Engineering.

Personal Notes.

William Bushey has been elected city surveyor at Salem, Oregon.

J. I. Hudson has been appointed city engineer at Portsmouth, Ohio.

H. E. Steinmann has been appointed city engineer at St. Charles, Mo.

George N. Randle has been elected city engineer at Sacramento, Cal.

Michael Bahin has been appointed city engineer at Springfield, Ohio.

M. D. Patterson has been re-elected city engineer at Northampton, Mass.

William F. Keene has been elected city engineer at Central Falls, R. I.

Charles M. Slocum has been re-elected city engineer at Springfield, Mass.

George A. Carpenter has been re-elected city engineer at Pawtucket, R. I.

Capt. Christopher Harrison has been re-appointed city engineer at Everett, Mass.

A. S. Moulton has been re-appointed superintendent of water-works, at Willimantic, Conn.

S. D. Newton has been appointed city engineer, at Knoxville, Tenn., to succeed Captain W. C. Crozer.

J. C. Ralston has been elected city engineer to succeed Charles McIntyre at Spokane, Wash.

B. C. Collier has resigned as assistant engineer in the bureau of highways, Boro of Bronx, New York City.

Henry Maetzel has been re-appointed city engineer, and Harry Holton first assistant city engineer at Columbus, Ohio.

Col. Augustus Pruyn, a retired civil engineer of Albany, N. Y., died recently at his home in that city, aged 77 years.

R. C. Hulme, city engineer and manager of the water-works department, at Belleville, Ontario, died January 29, aged 72 years.

A. C. Rapelje, of Poughkeepsie, N. Y., has been appointed county engineer of Dutchess County, N. Y., to succeed C. A. Fowler, resigned.

John J. Crilley, a prominent paving and sewer contractor at Milwaukee, Wis., died January 26, at his home in that city, aged 77 years.

Willard A. Gray, chief engineer at the Milwaukee plant of the American Bridge Co., died February 11, at his home in Wauwatosa, Wis.

Louis D. Foquet, of New Rochelle, N. Y., has been appointed division engineer in the New York Public Service Commission, First District.

Lawrence A. Reilly, a member of the Board of Freeholders, at Newark, N. J., died at his home in that city, February 6, of Bright's disease, aged 35 years.

Francis A. Foley has been appointed a member of the Board of Freeholders, at Newark, N. J., to fill the vacancy caused by the death of Lawrence A. Reilly.

James G. McClure, Charles G. Smith and John D. Moore have been appointed engineer members of the New Building Code Revision Commission of New York City.

Alexander Johnson, assistant engineer in the department of bridges, New York City, has been transferred to the position of consulting engineer in the same department.

Robert W. Hamilton, for a number of years superintendent of the Brooklyn Water Works system, died at his home in Dalton, Mass., February 12, at the age of 85 years.

W. W. Jackson has been re-engaged as engineer of maintenance of the water supply, and Hering & Fuller, of New York City, as consulting engineers, at Columbus, Ohio.

Charles H. Van Auken, city engineer at Cohoes, N. Y., and engineer of the Cohoes Company, was run over by a railway train recently and received injuries from which he died later.

D. D. Waldo and George T. Keith have been appointed resident engineers vision engineer in the city engineer's department, Milwaukee, Wis., to succeed Nic Engel, Jr., who died recently.

J. Walter Ackerman, who has been city engineer at Auburn, N. Y., for six years, has established an office in that city and engaged in consulting engineering practice in general municipal work.

Anthony P. Smith, president of the A. P. Smith Manufacturing Company, Newark, N. J., died at his home in that city recently, aged 61 years. Mr. Smith was one of the pioneer workers in water-works machinery in this country.

Rudolph Hering, of New York, made an exhaustive report upon garbage disposal for Milwaukee, Wis., which was presented to the City Council December 23, 1907. At the meeting held February 17 Mr. Hering was instructed to prepare plans for a plant to incinerate the garbage of the city.

MACHINERY AND TRADE

Street Cleaning.

Within the past few years many different methods of street cleaning have been tested, but it has been impossible to find any particular system that is equally well adapted for use in all departments, owing to the fact that the methods are controlled to a certain extent by the local conditions.

There is probably no branch of the municipal government which is criticized as often and as freely as the street cleaning department. This is because the work of this department is so conspicuous and has so much to do with the public health and convenience. In many cities on a windy day it is almost impossible for a pedestrian to keep his eyes open, owing to the large amount of dust which is blown about the streets. The push broom is responsible for this dust, inasmuch as patrol work during the day is done with push brooms, which only remove the coarser particles of dirt and do not pick up the fine dust which is so injurious and annoying. After looking over the different methods employed in many of the larger cities, we find that the street cleaner is only able to cover the surface which he is supposed to clean once a day at the most, and in the majority of cases the allotted space is so large that he is not able to cover that thoroughly.

It is a well known fact that Washington is one of the cleanest cities in the country. This reputation is largely due to the splendid methods employed by Mr. Twohey, superintendent in charge of the street cleaning department. The total area of paved streets which he had cleaned by hand during the fiscal year 1907 was 497,811,216 square yards; in 1907 the cost for this class of work was $90,675.05, as against $88,337.65 the previous year, an increase of $2,337.40 due to the greater area cleaned, and an increase of .004 cent in the cost per 1,000 square yards. The increased cost per 1,000 square yards was due to the longer haul for the disposal of the sweepings made necessary by the closing from time to time during the year of two of the public dumps that had been filled in. In considering these figures, it is also necessary to keep in mind the fact that to keep the streets and sidewalks within this territory free from all rubbish during the daytime an average of two hours out of the eight was devoted by the laborers to picking up paper, etc. This means that but six hours a day were actually devoted to sweeping. The average cost of cleaning the streets in Washington has been 19 cents for 1,000 square yards, which is very low, considering the local conditions and traffic. Other cities have had a lower cost where traffic conditions have not been so hard to contend with. In Washington each laborer has been assigned a street surface area of between 9,000 and 10,000 square yards per day to clean. Even with this splendid showing, Mr. Twohey states in his yearly report to his city that he has not yet reached the standard which he desires.

The above figures deal only with the smooth paved streets. Horse-power machines are used at night and for the day sweeping a hand street sweeper called the "Peerless" is used. It is largely due to the use of this machine that the streets are kept in such good condition and that the dust nuisance is done away with. These sweepers appeal to the laborers themselves, owing to the fact that the dust which is so injurious to them is not raised in sweeping. The tendency will be for the adoption of this machine by all cities having fairly smooth paved streets, both because of the improved condition in which the streets can be kept by their use with the same amount of labor and because of the saving effected and the improvement of the general health of the laborers.

The good results in Washington can be obtained in other cities if the same up-to-date methods are used.

The Hercules Concrete Mixer.

The Century Cement Machine Company, Rochester, N. Y., have prepared a handsome catalogue for 1908 which describes the Hercules concrete block and maxing machinery, curb and gutter outfits and tools for cement workers.

The mixer has some interesting points. Mixer and engine are mounted on a truck and the hoppers, feeding into the end of the horizontal mixer cylinder, are low enough so that the workmen can shovel into them directly from the ground. Gravel or broken stone hopper is on one side, sand hopper on the other and cement hopper between. A plunger runs through the lower part of each hopper, the plungers being operated by the same engine which turns the drum. After the materials are placed in the hoppers these plungers force exact proportions of them into the end of the mixing cylinder. The proportions are changed instantly by changing the length of the plunger stroke. Upon entering the drum the materials are carried upward and forward by means of stationary deflectors, producing a perfect dry mix before the water is applied. The mixer can thus be run either as a batch mixer or continuously. A two and one-half horse-power gasoline engine operates it.

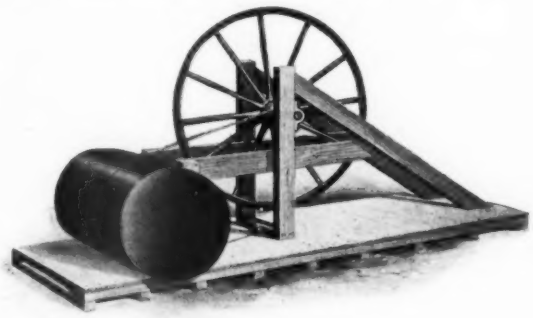
How to Apply Asphalt Fillers to Brick Pavement.

The Standard Asphalt and Rubber Company, First National Bank Building, Chicago, Ill., have issued the "Asphalt Filler Book," giving the standard specifications for asphalt for filler and full description of method of applying their Sarco filler. The description runs as follows, reference being made to the accompanying illustrations:

The Sarco filler arrives in light sheet steel drums, from which it may be readily removed by cutting the sides and ends of drum and rolling the material out. After the material has been removed from the drum it should be cut up into smaller pieces to assist in the melting. The operation of a machine for cutting up the block asphalt is shown in the first illustration. The wheel is turned so as to draw the wire through the material, which it does rapidly and effectively.

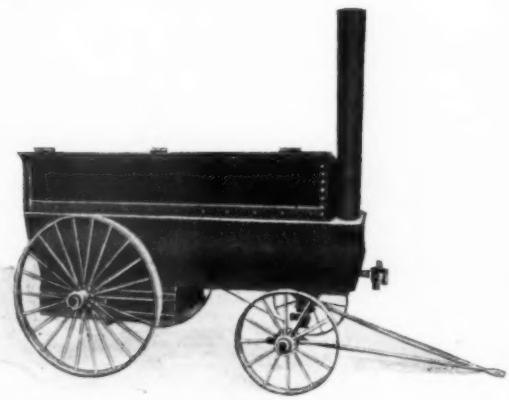
The melting is done in a kettle, which should be of such size that the melting of fresh material in it all the time does not interfere with the removal of the heated filler. The temperature of the material used must be sufficiently high to insure its being easily poured. This means that the temperature in the kettle should be 400 degrees, which will allow sufficient drop to keep it above 350 degrees when poured on the street. The second cut shows this kettle on the street.

The filler is poured in the joints of the brick from specially prepared cans, which consist of a funnel shaped receptacle, narrowed down to a tip at one end, furnished with a handle projecting from the other and a valve rod



MACHINE FOR CUTTING UP ASPHALT CAKES.

controlled by the operator for opening the delivery at the end tip. The third cut shows the pouring can. The pouring is done by placing the tip in the joint of the brick, walking slowly backward at the same time allowing the filler to flow so as to completely



STREET ASPHALT KETTLE

fill each joint. The tip rests in the joint and will, therefore, act as a guide, preventing the spilling of the material on the surface provided reasonable care is taken.

To secure the most economical service in filling the joints in the pavement the labor and equipment must be

so arranged as to give an efficient distribution of the expense for continuous activity. In this connection experience has proven that the following equipment and labor will be sufficient and an economical method of handling the work, ensuring its quick completion.

Equipment necessary for from 700 to 1,000 yards per day: 1 kettle, 8 pouring cans, 24 points, 1 cutter.

POURING CAN FOR ASPHALT FILLER FOR BRICK PAVEMENT.

Labor: 1 foreman, 1 kettleman, 2 carriers, 8 pourers, 1 laborer to cut up material, etc.

This force may be increased as to carriers, pourers, etc., before requiring additional kettlemen and laborers, and may be reduced as to pourers and laborers only.

Testing Hardness of Materials.

Hardness is that property of a material which resists a change in the relative position of the molecules of the material without separating them from each other. It may be tested and recorded as the resistance to indentation.

If indentations were made in various substances by the same force transmitted through the same medium, the relative hardness of the different materials could be recorded by measuring the depth of the indentation in reach. However, the accurate measuring of the depth of such indentation is difficult work and requires special instruments and test pieces. To overcome this difficulty a method must be pursued which will provide a means of quickly and accurately determining the resistance to indentation of a material.

The Ballentine method consists in allowing a hammer of specified weight to fall through a specified height (as obtained by experiment) on an anvil to which is connected a test pin which rests on the specimen to be tested. A penetration in the material is obtained and the resistance encountered is measured by the blow being transmitted to the test pin through a soft metal recording disc which is held at the lower end of the drop hammer. This soft disc thus offers a constant resistance to deformation and will be penetrated to a depth varying as the resistance the pin encounters in penetrating the material being tested.

In other words, the depth of penetration of the lead recording disc will vary as the hardness of the material being tested and the harder the metal, the deeper the penetration will be in the recording disc.

The apparatus consists of a guiding tube encasing a drop hammer which is held at the top of the tube by a spring latch. The lower end of the hammer is provided with a small anvil to which is clamped a standard soft metal recording disc by means of a spring clamp. At the lower end of the tube a test pin holder is held in a guide in which are inserted the test pins for testing the various materials. The upper end of the test pin holder is provided with an anvil the same diameter as the one on the lower end of the hammer. A small spirit level is inserted in the top of the tube for leveling the apparatus. Two slots are cut in the guiding tube for inserting and removing the recording disc.

The machine can be used to test all materials used in the various mechanic arts that can be tooled or machined, except those that require an abrasive substance for their reduction, such as hardened steel. This material would be too hard and could not be indented.

Two test pins are provided, one for soft materials such as lead and babbit metals, and another for harder materials, such as iron and steel. The pin for hard material is very short and small in diameter, while the pin for soft material is longer and larger in diameter.

The great advantage of this hardness tester is that it is entirely self-contained and well adapted for either laboratory or general shop use. Tests of hardness can be made either on small test specimens or directly on large parts in process of manufacture.

To determine the penetration the instructions are to measure with a micrometer to the fractional part of one thousandth of an inch the thickness of the recording disc before placing it on the drop hammer. After the test has been made, measure the thickness of the disc as left between the two recording anvils with the same care, and

the difference between the two dimensions will be the penetration of the recording disc.

Bitulithic Pavement in the Courts.

On February 20 the Supreme Court of Illinois rendered a decision to the effect that the Chicago South Park Commissioners have the right to let contracts without advertisement when four of the five park commissioners vote in favor of this procedure. This in effect declares valid the contract made for paving portions of Michigan and South Park avenues and Thirty-Third street boulevards with 72,000 square yards of bitulithic, which was let at private contract without advertisement after bids had been received for bitulithic, asphalt and creosoted wood block and had been rejected.

On February 10 Judge Henry J. Swan, of the District Court of Detroit, Mich., dismissed the suit brought by Warren Brothers Company against the city of Owosso for infringement of their patent No. 727,505 on a pavement embodying certain proportions of ingredients. The suit will be carried to the higher courts.

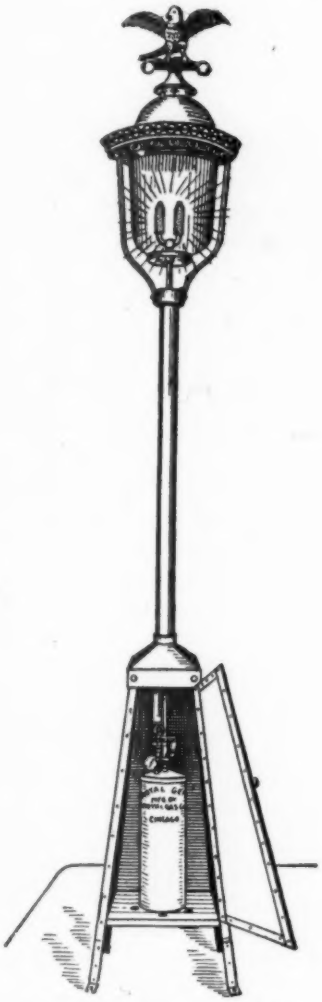
Warren Brothers Company claim that the Owosso pavement infringes other patents which they own, but as these are now in litigation with the city of Duluth, Minn., they were not included in the suit brought against Owosso, but are reserved for further action when the Duluth suits have been decided.

Street Lamps.

Accompanying this article is a cut illustrating a design for a street lamp and standard made by the Royal Gas Light Company, 208 East Kinzie street, Chicago, Ill. It is intended for cities and towns without gas or electricity and for the districts in towns and cities which are not yet supplied with gas or electricity, and is often used in the place of the other lights on account of less cost for the same illumination.

It will be noted that the gasoline tank and generator are located in a locked chamber at the base of the lamp post where they can be conveniently operated and protected. The tank has capacity for 4 gallons of gasoline and the same space for the air pressure, which is only 10 pounds. The lamp mantle is protected by inner and outer globes and can be lighted after starting the generator by slipping the asbestos torch up through a slide under the inner globe. An automatic shut-off is provided, which can be set for any desired time and will put out the lamp when that time has passed.

The lights are rated at full 1,000 candle power and light up a distance of 600 feet in all directions. Four gallons of gasoline will run the lamp 60

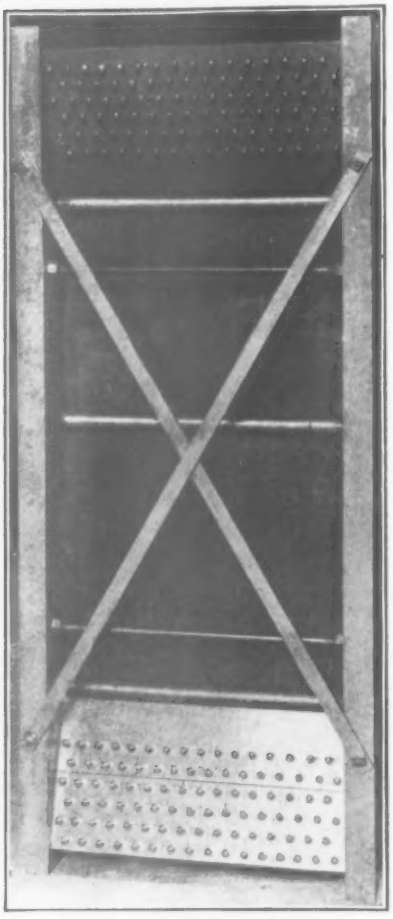


ROYAL GEM STREET LAMP.

hours. An electric arc lamp costs something like $70 a year to operate. The first year's cost of a Royal Gem lamp, including the cost of the lamp, is less than this, and each succeeding year shows far greater saving.

The Royal Gas Light Company will furnish any municipality a lamp for

30 days' trial without charge. The lamp is the result of practical development and has been in use for several years upon city streets. Descriptive circulars and lists of names of users of the lamps will be furnished on request. The company also make lighting devices of every description.



PIANO WIRE CLAY SCREEN.

Portsmouth Machine and Casting Co., Portsmouth, O.

A Clay Screen for Brick Plants.

Just at this time the Portsmouth Machine and Casting Company is calling attention to a piano wire clay screen. Their new screen is 30 by 40 inches, and is made of the best piano wire obtainable. Each wire is held by two keys similar to the pins holding the wires in a piano, so that in case one wire breaks it can be removed and replaced without interfering with other wires. The accompanying photograph shows the screen ready for operation. The manufacturers claim that the screen is not affected by wet weather and that repairs are trifling in amount; also that it will screen more material than a plate or ordinary wire screen several times as long, and will increase the output of a brick plant in wet weather from 25 to 50 per cent. over other screens. The necessary height of an elevator and other construction is much curtailed by its use.

The company make other kinds of brick making machinery and all kinds of municipal castings for sewers, paving, water supply, etc. Their address is Portsmouth, O.

Protecting Concrete Curb.

Plain concrete curbing is coming in use to a very large extent, and it becomes apparent that the outer edge or corner of a concrete curb should be reinforced with metal of such shape and strength that it will resist all shock or abuse to which curb is liable, without becoming loosened to the slightest extent from its contact with the concrete. It is also found important that this metal corner bar should be galvanized so that it may not rust, causing stain and disagreeable appearance as well as wasting of the metal. Another feature which many trials of different shapes of metal have demonstrated, is the necessity for a corner bar for curb protection to have a very heavy and solid head to withstand the shock of blows from any heavy trucks or vehicles which may come in contact with same. If the metal corner protection bar be made much less than an inch thick, it will spring or yield to any heavy external shock, and in such event, there might develop a slight opening between the metal and the concrete, which, admitting moisture and frost, will rapidly loosen the bar so that it becomes no longer a protector of the concrete.

Many demonstrations have also proved that it is impossible to anchor any kind of bar so that it can be depended upon to remain as placed, unless the anchorage is a solid and integral part of the bar itself. A bar once loosened from the concrete, rapidly loses its value as a protector, when it depends only upon bolts to hold it.

It is sometimes claimed that the bolts extending from a corner protecting plate or bar backwardly into the concrete curb add value to the curb as a reinforcement. As a matter of fact

it is more apt to be a disadvantage, for these bolts are inserted after the concrete is placed, and they only serve to reinforce the curb against a possible longitudinal break, whereas more than ninety per cent. of all failures of concrete curbing are sectional breaks, and reinforcements placed sectionally would be apt to weaken the concrete at the place where the bolt or rod is located. Reinforcement should extend horizontally throughout the whole length of curb, with joints at proper intervals.

Experience has shown that joints every ten feet are preferable to a greater or less length.

If of less length more labor is required and there is greater liability that the curb lengths will shift their positions. A concrete body of the usual size for a good curb (6x20 inches) has ample strength to sustain itself under almost any conditions if not made more than ten feet long, but is not strong enough to carry itself without a probability of its breaking somewhere about the middle of this length through expansion or contraction if of much greater length.

That concrete curbing should be laid separately from the gutter, for the reason that the gutter will not last as long as the curbing, and it should be possible to renew it without disturbing the curb, is the opinion of some.

These questions are considered at length, and in a very practical manner in a recent booklet of directions for laying concrete curbing, published for free distribution by the Steel Protected Concrete Co., 1618 Real Estate Trust Building, Philadelphia, Pa.

Trade Publications.

W. H. Schott, American Trust Bldg., Chicago, Ill., as the result of ten years of experience has devised a sliding scale or table for determining the amount of radiation necessary to heat a room of given area, height of ceiling, length of exposed wall, width, length and area of glass exposures. The results are said to have a factor of safety of about 7.5 per cent., maintaining 10 degrees in the room with an outside temperature of 30 degrees below zero. It is applicable to steam or water radiation and to rooms of any size. It can be obtained of Mr. Schott for $1.

The Adjustable Steel Centering Company, Fond du Lac, Wis., issue bulletin No. 2, showing the methods of adjusting and using their molds for various sizes and shapes of sewers and conduits. It also gives sizes, weights and average cost of using when labor and purchase price are distributed over a length of sewer.

The Ashley system of house sewage disposal is illustrated in the catalogue of the House-Sewage Disposal Company, Chicago, Ill.

Bulletin No. 45 of the Universal Portland Cement Company illustrates houses, bridges, piers, abutments, dams, large buildings and retaining walls in which Universal Portland cement has been used.

The Chicago Concrete Machinery Company, Chicago, Ill., issued a handsome special edition of their catalogue of concrete mixing, rock crushing and earth handling machinery for use at the Buffalo convention. A new revised and enlarged edition will be issued in March.

The Jeffrey rubber belt conveying machinery is described in one of the latest catalogues issued by the Jeffrey Manufacturing Company, Columbus, Ohio.

The Universal safety tread for stairways and for steps to vehicles is shown in the catalogue of the Universal Safety Tread Company, Boston, Mass.

Trade Notes.

ASPHALT.

Indianapolis, Ind.—This city received bids, Feb. 12, for furnishing a municipal repair plant, from Hetherington & Berner, of this city, and the Iroquois Iron Works, of Buffalo, N. Y. Action on the bids was deferred.

Shawnee, Ok.—City council appointed a committee recently to visit Fort Smith, Ark., and inspect the municipal paving plant in that city,w ith a view to establishing one here.

Jersey City, N. J.—The American Technolith Co., 242 Washington St., has been incorporated to manufacture a patent paving, by Bernard Nove, Herbert Salinger, and I. Faerber Goldenhorn.

Cleveland, O.—The F. D. Cummer & Son Co. advise us that they have just sold to the Warner-Quinlan Asphalt Co., of Syracuse, N. Y., a Cummer one-car portable asphalt paving plant to be delivered April 15. This makes the fifth order for portable plants received from the Warner-Quinlan Company by the Cummer Company.

BRICK.

Redondo, Cal.—The plant of the National Building & Paving Brick Co. has been completed and the manufacture of paving blocks was begun about February 10.

CEMENT.

Newark, N. J.—The Riverside Supply & Manufacturing Co. has been incorporated to manufacture Portland cement, limestone, artificial stone, etc.,

by Frank J. Hill, of South Orange, N. J., and Wm. F. Merritt and Robert H. Doland, of Newark.

Iola, Kas.—The Kansas Portland Cement Co., of Iola, the Independent Portland Cement Co., of Neodesha, and the Indian Portland Cement Co., of Neodesha, have consolidated and will be known as the United Kansas Portland Cement Co. The officers of the consolidated company are: President, George Nicholson; vice-president, A. B. Cockerill; treasurer, L. L. Northrup; attorneys, A. H. Campbell and John F. Goshorn. The company's offices will be in Iola.

Yankton, S. D.—The manufacturing department of the Western Portland Cement Works has closed for a short time for the overhauling of machinery. This has been customary with the company each year for some time.

Oskaloosa, Ia.—McGutchen & Shahan have begun the operation of their cement plant.

Nowata, Ok.—The British-American Portland Cement Co. contemplates building a plant with capacity for manufacturing 3,000 barrels of Portland cement. The company's general offices are with F. C. Vincent & Co., 900 Scarritt Bldg., Kansas City, Mo., and its officers are as follows: President, William Peet, Kansas City; vice-presidents, John S. Logan, of St. Louis; F. G. Thrall, of Eureka, Kas., and J. E. Campbell, of Nowata; treasurer, J. H. Harrington; secretary, W. D. Vickers, and general manager, Frederic C. Vincent, of Kansas City, Mo.

Craigsville, Va.—The Virginia Portland Cement Co. will double the capacity of its plant.

St. Louis, Mo.—Robert W. Hunt & Co. have established their St. Louis office, which is in charge of Mr. C. W. Gennet, Jr., at 1445 Syndicate Trust Bldg. They have arranged to locate their chemical and cement laboratory in the same building.

Ithaca, N. Y.—The Cayuga Lake Cement Co. have increased their capital stock $300,000.00 and have plans nearly completed for increasing the capacity of their works to 2,500 barrels per day, and have made arrangements for a steam canal boat with consorts to operate on the Erie Canal between their works and Buffalo and all points on the Erie Canal to New York, which will give them water transportation to all points on the Great Lakes and the Seaboard.

CONCRETE BLOCKS.

Hudson, Wis.—The Hudson Hydraulic Stone Co. has been incorporated to manufacture building blocks.

Columbus, Neb.—C. J. Scott will erect a cement stone plant here.

Toledo, O.—The Diamond Cement Machine Co. has been incorporated to make cement block machines, by J. G. Gubbill, H. J. Chittenden, Charles E. Chittenden, Charles Rothgert and John Vogt.

Fargo, N. D.—The Fargo Concrete Co. has been incorporated by George A. Anderson, C. H. Anderson, and L. F. Anderson. The company will engage in the manufacture of concrete blocks, fence posts and tiles.

Evansville, Ind.—The Keystone Concrete Co. has been incorporated by Charles W. Johann, Charles H. Wheeler, Eli M. Stingle, and William M. Johann.

Ashton, Ill.—The highway commissioners of this town have purchased a complete portable stone crushing plant of the Indiana Road Machine Co., of Ft. Wayne.

PURCHASE OF MACHINERY.

Orillia, Ont., Canada—Special. J. O. Coates is on the market for cable-ways, concrete mixers and excavating machines.

Rugby, N. D.—Bids are asked until 2 p. m. March 2 for furnishing road graders. John Kellesvig, co. audt.

Brunswick, Ga.—This city contemplates the purchase of a plant for making wood blocks for paving purposes. J. B. High, cy. engr.

Albany, Ga.—The county commissioners contemplate the purchase of a rock crusher and the city the purchase of a 100-ton road roller.

PURCHASE OF MATERIALS.

Orillia, Ont., Canada—Special. J. O. Coates advises us that he is in the market for the purchase of lumber, cement, stone, hardware, structural steel and reinforced materials for concrete.

MISCELLANEOUS.

Milwaukee, Wis.—The Milwaukee Monument Company has changed its name to the American Granite Company, and instead of manufacturing monuments will do a general business in granite, including granite paving blocks.

Trenton, N. J.—The Berger Trap Rock Co. has been organized and incorporated by M. F. Berger, G. L. Berger and F. M. Gress. The Larsen-Lawrence Trap Rock Co. has been incorporated by Magnus Larsen, George W. Lawrence and Lawrence E. Brower. The Hoboken Trap Rock Co. has been incorporated by Warren L. Jacobus, Monte F. Morehouse and Alfred B. Van Liew.

New Paris, O.—The Rheinheimer Stone Co. has been incorporated by David Rheinheimer, C. L. Rheinheimer, Jacob Rheinheimer, Walter Rheinheimer and Edgar L. Rheinheimer.

SEWERS.

Harrisburg, Pa.—State Health Commissioner Dixon has sent to the various boroughs and townships on the watersheds of Darby and Cobb's Creeks a letter requesting them to submit to him plans for either joint or separate sewage disposal by the 1st of October.

Waco, Tex.—The contract with the Charles T. Derr Construction Co. for constructing a sanitary sewerage system was annulled Feb. 13. About one-third of the system has been completed, but the council's action followed charges made that the company was not fulfilling the terms of its contract.

Linton, Ind.—City council has consented to the transfer of the contract for constructing the sewerage system from Morgan & Slinkard, the original contractors, to the Green & Sons Co., of Chicago. The system will cost $65,000. The contract was awarded, in October, 1907, to Morgan & Slinkard.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

Santa Cruz, Cal.—Special. Chester A. Wood advises us that several miles of cement sidewalk and sewers are being constructed. This city has a casino costing about $100,000, a pleasure pier, and 1-4-mi. of board walk.

San Leandro, Cal.—An ordinance has been introduced in the board of town trustees providing for the application of crude oil to all unpaved sidewalks. Experiments made with this process last summer proved so satisfactory that it was proposed to make such application compulsory.

CONTEMPLATED WORK.

Ida Grove, Ia.—Paving is proposed for the business streets.

Portland, Ore.—Belgian block paving is contemplated for E. Morrison st.

Jacksonville, Fla.—Jessie st. from Ionia to Talleyrand will be paved.

Taylorville, Ill.—Plans are being prepared for about 4-mis. of paving.

Atlanta, Ga.—Rock and chert paving is contemplated for a large number of streets.

Peoria, Ill.—Brick paving is contemplated for S. Glendale ave. and Farraday st.

Champaign, Ill.—A petition will be circulated asking for the paving of S. 4th st.

Sigourney, Ia.—Council is considering the question of paving.

Sullivan, Ind.—Brick paving is contemplated for 3-mis. of the principal streets.

Bessemer, Ala.—The question of paving several streets and avenues is being agitated.

Belleville, Ill.—Ordinances have been prepared for paving sundry streets with brick.

Buffalo, N. Y.—Special. The repaving of Johnson and Amherst sts. is contemplated.

Knoxville, Tenn.—Bids will be asked at once for paving in 16 improvement districts.

Blairsville, Pa.—The residents on Campbell, Market and Stewart sts. have asked for paving.

Cincinnati, O.—Legislation has begun for resurfacing a large number of streets with asphalt.

Gibson City, Ill.—About 36,087-sq. yds. of brick paving is contemplated. C. W. Knapp, mayor.

Sycamore, Ill.—An ordinance has been adopted to pave Maple, Exchange and California sts.

Muncie, Ind.—The brick sidewalks in the business district will be replaced with cement walks.

Marinette, Wis.—The question of paving Pierce ave. and lower Main st. is being considered.

Louisville, Ky.—Plans will be prepared for paving sundry streets with brick, granite and asphalt.

Evansville, Ind.—Resolutions have been adopted for paving 3 streets with brick and 3 with asphalt.

Rock Island, Ill.—Brick paving is contemplated for 15th st. from 1st to 2nd ave. Mayor Schaffer.

Little Rock, Ark.—The property owners in Scott st. have asked for asphalt paving from 3rd to 15th sts.

Knoxville, Tenn.—The residents in Highland ave. have asked for the construction of sidewalks and crosswalks.

Anna, Ill.—Plans are being prepared for 25,000-sq. yds. of brick paving on concrete base with sandstone curbing.

Denver, Colo.—The park board has voted to issue the necessary bonds for the proposed Montview boulevard system.

Freeport, Ill.—A resolution has been adopted providing for the paving of N. Galena ave. with brick. Mayor Dittmar.

Knoxville, Tenn.—Park City will vote May 13 on the issue of bonds for street improvements, constructing sewers, etc.

Ft. Madison, Ia.—This city contemplates constructing about 16 blocks of street paving next spring. C. H. Finch, mayor.

Springfield, O.—Estimates for macadamizing Pleasant and Karr sts. and Grand ave. are being prepared by M. J. Bahin, cy. engr.

Fond du Lac, Wis.—Brick paving is contemplated in S. Main, W. 1st, Marr, Portland and other streets. Cy. engr. Pettibone.

Trenton, N. J.—An ordinance has been passed providing for the paving of Fall st. from Warren to Union, with asphalt.

Mansfield, O.—Resolutions have been passed authorizing that ordinances be prepared for improving Chestnut st. by paving.

East St. Louis, Ill.—Plans are being prepared for paving various streets with brick on concrete base. Wm. J. Crocker, cy. engr.

Terre Haute, Ind.—Improvement resolutions were adopted Feb. 10 providing for the paving of Osborne and S. 9th sts. with brick.

Mt. Sterling, Ky.—The question of constructing brick paving in the streets of this city is being pushed by the council committee.

Davenport, Ia.—Council has under consideration the construction of $27,000 worth of brick paving and $20,000 worth of asphalt paving.

North Yakima, Wash.—A resolution has been passed directing the city engineer to prepare estimates, at once, for paving Yakima ave. with brick.

Baltimore, Md.—Specifications for paving Whiteford st. have been approved. Plans are being prepared for paving North ave. from Payson to 10th sts.

Youngstown, O.—A resolution will be introduced in council providing for

the repaving of E. Federal st. from Basin st. to East End bridge.

Lincoln, Neb.—Contracts will be let soon for constructing 5,000-sq. yds. of brick and 9,000-sq. yds. of asphalt paving. Wm. Grant, cy. engr.

Ft. Wayne, Ind.—A petition is being circulated asking for the construction of cement sidewalks in Washington st. from Barr to Glasgow ave.

South Omaha, Neb. — About 18,000-sq. yds. of brick paving and 4,000-lin. ft. of curb and gutter is contemplated for Q st. M. E. Rohrbaugh, cy. engr.

Kansas City, Mo.—Bids for constructing a boulevard in Washington ave. from 3rd to 8th sts. will probably be asked very soon by the West Side park board.

St. Paul, Minn.—Plans and specifications for boulevards and curbing St. Anthony ave. from Rice to Dale sts. have been submitted to the board of public works.

New Orleans, La.—The paving committee of the Progressive Union decided, Feb. 7, to start a campaign to pave every unpaved street in this city within the next five years.

San Francisco, Cal.—Plans are being prepared for constructing a concrete training wall and wharf along the north side of the estuary. Mayor Mott.

Marinette, Wis.—About 1-mi. of macadam roadway is proposed in John Henes park, and the question of repaving Main st. and Pierce ave. is being considered.

St. Louis, Mo.—Wood block paving will be substituted for granite paving at most of the important street intersections in the downtown district during next summer.

Elgin, Ill.—Plans and specifications have been prepared and bids will be asked for 20,000-sq. yds. of asphalt paving and 41,000-sq. yds. of brick paving. C. E. Plum, cy. engr.

Syracuse, N. Y.—Plans and estimates for paving Temple st. from S. Salina st. to Onondaga creek, University Place, from Walnut to Ostrom aves., and Plum st. from Wilkinson st. to W. Belden ave. have been submitted by Henry C. Allen, cy. engr.

San Antonio, Tex.—Mayor Bryan Callaghan authorized Fritz Russi, st. comr., Feb. 8, to prepare estimates of the number of heavy hexagon mesquite blocks needed for repaving Alamo Plaza, Main Plaza, Military Plaza, Paschal Square, part of Houston st., Loysoya and other streets.

Roanoke, Va.—The county supervisors have appropriated $5,000 for improving 1-2-mi. of each of the five roads entering this city, with the understanding that the city will pave or macadamize the streets leading to these roads.

New Albany, Ind.—The hearing of objections on the proposed paving of W. Main st. has been deferred until April 4.

Richmond, Ind.—The bd. of pub. wks. has decided to pave 30th st. from Meridian to Central ave. with asphalt instead of wooden blocks.

Olympia, Wash.—The paving of 4th and Main sts. in the business districts is contemplated.

Champaign, Ill.—Brick paving is contemplated for John St. requiring the following: 7,250-sq. yds. exca.; 7,985-sq. yds. brick paving on concrete foundation with asphalt filler; 5,462-lin. ft. sq. yds. brick paving on concrete foundation with asphalt filler; 5,462-lin. ft. combined concrete curb and gutter; 305-lin. ft. stone retaining curb; 120-lin. ft. false curb; 40-lin. ft. gutter plates, catch basins, tile drains, etc. Shields A. Blaine, prest. bd. local impvts.

CONTRACTS TO BE LET.

Fork, Minn.—Bids are asked until May 1 for constructing 5-mis. of roads. J. P. Lein, town clk.

Columbia City, Ind.—Bids are asked until Mar. 9 for paving Market and Main sts. with brick. Council.

Bemidji, Minn.—Bids are asked until Mar. 3 for constructing county roads. John Willmann, co. audt.

Fort Wood, N. Y.—Bids are asked until April 1 for constructing roads and walks. C. C. Burnell, Q. M.

Spencer, Ind.—Bids are asked until Mar. 3 for constructing pike roads. George W. Edwards, co. audt.

Vincennes, Ind.—Bids are asked until Mar. 5 for constructing over 2-mis. of gravel road. Co. comrs.

Toms River, N. J.—Bids are asked until Mar. 17 for constructing a gravel road. John A. Hyer, freeholder.

Cincinnati, O.—Bids are asked until Mar. 13 for improving Edmundson road. Fred Dreihs, clk. bd. co. comrs.

Salem, Ind.—Bids are asked until Mar. 2 for constructing Livonia and Orleans roads. Sam G. Ellis, co. audt.

Joliet, Ill.—Bids are asked until Mar. 2 for paving Campbell st. with asphalt. Wm. S. Welch, clk, bd. local impvts.

Lebanon, Ind.—Sealed bids are asked until Mar. 2 for constructing a gravel road. B. F. Herdrich, co. audt.

Madison, Ind.—Bids are asked until April 7 for constructing 8,450-ft. of macadam road. G. F. Crozier, co. audt.

Versailles, Ind.—Sealed bids are asked until Mar. 3 for constructing macadamized roads. Nicholas Volz, co. audt.

Watertown, Wis.—Bids are asked until Mar. 14 for improving Main, Church and N. Church sts. Frank S. Weber, cy. clk.

Rockville, Ind.—Bids are asked until Mar. 4 for constructing a gravel road in Washington twp. H. A. Henderson, co. audt.

Freehold, N. J.—Sealed bids are asked until Mar. 11 for constructing gravel roads. Wm. B. Conover, dir. freeholders.

Washington, D. C.—Bids are asked until Mar. 5 for resurfacing roadways on Antietam battlefield. Major M. Gray Zalinski, Q. M.

Neenah, Wis.—Bids are asked until Mar. 16 for constructing 9,000-sq. yds. of brick paving in Wisconsin st. H. L. Sweet, cy. engr.

Peru, Ind.—Bids are asked until Mar. 3 for grading, paving, bridging and otherwise improving various roads. Chas. Griswold, co. audt.

Vevay, Ind.—Bids are asked until Mar. 2 for constructing a gravel road in York twp. and one in Posey twp. L. J. Woolen, co. audt.

Paterson, N. J.—Sealed bids are asked until Mar. 11 for grading and macadamizing the Midvale road. Winfield S. Cox, chmn. road com.

Monticello, Ind.—Sealed bids are asked until Mar. 3 for constructing 3,975-ft. of stone road in Jackson twp. J. L. Ackerman, co. audt.

Arlington, Va.—Bids are asked until Mar. 16 for grading at Arlington National Cemetery. Maj. M. Gray Zalinski, Q. M., Washington, D. C.

Winchester, Ind.—Bids are asked until Mar. 18 for paving Washington, Franklin, N. Main, S. Main, North and Pearl sts. with brick. Common coun.

Fort Scott, Kas.—Sealed bids are asked until 5 p. m. Mar. 3 for paving Crawford st. with vitrified brick on concrete base. J. O. Brown, cy. clk.

New York City.—Bids are asked until Mar. 4 for excavating and removing rock in hydrant trenches. John H. O'Brien, comr. water sup., gas and elect.

Sandusky, O.—Bids are asked until Mar. 9 for widening the roadway at the approaches over the Monroe st. concrete bridge. Chas. Kuback, co. audt.

Perth Amboy, N. J.—Sealed bids are asked until Mar. 18 for furnishing stone for macadamizing and graveling roads. F. H. Pownall, dir, bd. freeholders.

Crookston, Minn.—Bids are asked until Mar. 10 for constructing cement sidewalks, driveways, street crossings and sidewalk intersections. A. M. Childs, cy. clk.

Zanesville, O.—Sealed bids are asked until Mar. 16 for paving and curbing

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Brighton boulevard. Asphalt blocks will be used. J. T. Hahn, secy. B. P. S.

Dayton, O.—Sealed bids are asked until Mar. 7 for grading and graveling Burkhart ave. on Smithville hill. Wm. Gruenewald, prest. trustees of Madriver twp.

Corning, N. Y.—Sealed bids are asked until Mar. 5 for 16,250-sq. yds. of macadam paving, and cement curbs and gutters. J. T. Hall, clk. B. P. W.

Clinton, Ia.—Sealed bids are asked until Mar. 10 for 2,557-sq. yds. of vitrified brick paving, 143-cu. yds. excess grading, 1,150-lin. ft. gutter and 85-lin. ft. curb. W. E. Hayes, cy. clk.

Chattanooga, Tenn.—Bids are asked until Mar. 10 for resurfacing Market, 6th and Walnut sts. with asphalt, aggregating 10,334-sq. yds. of paving and 807-sq. yds. of brick gutters. H. F. Van Dusen, chmn. B. P. W.

Racine, Wis.—Sealed bids are asked until Mar. 7 for constructing 5,412-sq. yds. of brick paving, 1,161-lin. ft. concrete gutter, 1,118-ft. concrete combination curb and gutter, and 947-cu. yds. excavation. P. H. Connolly, chmn. B. P. W.

New Orleans, La.—Bids are asked until Mar. 12 for repairing the roadway leading to National Cemetery, Vicksburg, Miss.; also repairing roadway, bridge and culvert leading to National Cemetery at Port Hudson, La. Capt. Arthur Cranston, Q. M.

Oil City, Pa.—Sealed bids are asked until Mar. 9 for paving Graff, Stout, Spruce, Polaski and Dunembe sts. and Harriott ave., requiring 10,000-cu. yds. excavation, 7,610-lin. ft. curbing, 12,130-sq. yds. brick paving, 700-cu. yds. concrete retaining wall, 100-ft. 12-in. sewers, 400-ft. sewers, and 25 sewer inlets. C. W. Mullalley, controller.

CONTRACTS AWARDED.

Thomasville, Ga.—The contract for paving Broad st. was awarded to W. H. Bowe, of Augusta.

Mobile, Ala.—Fleming & Co., of this city, secured the contract for paving Swopes Alley.

Jackson, Mich.—The contract for paving Wildwood ave. was awarded to Kneal & Ryan, of Lansing, for $18,000.

Seattle, Wash.—The contract for paving Ballard ave. was awarded to the Sparger Concrete Co. at $2.75 a sq. yd.

Lebanon, Ill.—The contract for paving St. Louis st. was awarded to Reeb Bros., of Belleville, Ill., for $21,900.

Toledo, O.—The Ohio Paving Co. was awarded the contract for repaving Fulton st. with vitrified block, for $7,309.50.

Cairo, Ill.—The contract for paving Washington ave. with vitrified brick was awarded to Roy L. Williams, for $123,761.69.

Rockville, Ind.—The contract for constructing a number of roads was awarded to John Pittser and to Gillian, Morris & Ireland.

Spokane, Wash.—The contract for paving ten blocks of N. Monroe st. was awarded, Feb. 6, to the Barber Asphalt Co., for $52,800.

Des Moines, Ia.—James Horrabin was awarded the contract for paving 6th ave. and 7th st. with creosoted wood blocks, at $2.39 a sq. yd.

Tacoma, Wash.—The contract for paving Pacific ave. with sandstone blocks on concrete base was awarded to D. A. Williams, for $52,643.

Louisville, Ky.—The contract for constructing a free turnpike was awarded, Feb. 6, to Wm. O. Sweeney, of Jeffersonville, Ind., for $17,972.

Tyler, Tex.—The contract for constructing 18,000 sq. yds. of paving in E. Ferguson and W. Ervin sts. was awarded to Ockander Bros., of Waco, Tex.

Baltimore, Md.—Warren Brothers Co., of Boston, Mass., secured the contract, Feb. 12, for paving Heath st. from Light to Johnson, at $2.45 a sq. yd.

Dixon, Ill.—The contract for constructing cement sidewalks in Nachusa and Grant aves. and 3rd st. was awarded to J. W. Kelley, of this city, at 9 cts. a sq. ft.

Attleboro, Mass.—The contract for constructing a new highway connecting this city and Pawtucket was awarded to Eveline Bros., of New Britain, Conn., Feb. 8.

Ballinger, Tex.—The contract for grading and macadamizing the principal streets in the business district was awarded to the Ballinger Sanitary Sewerage Co.

Los Angeles, Cal.—The Western Paving Co. secured the contract for paving Jefferson st. with asphalt, and the Barber Asphalt Co. the contract for paving Lake st.

Charlotte, N. C.—The contract for constructing cement sidewalks on the south boulevard in Dilworth was awarded, Feb. 17, to J. W. Haas, at $1.20 a sq. yd., or $2,706.80.

Huntsville, Ala.—The contract for paving the streets around the Public Square with brick was awarded, Feb. 8, to the Graves-Hale Paving & Brick Co., at $1.95 a sq. yd., or $21,000.

Massillon, O.—Wm. Vogt & Sons secured the contract for paving Diamond alley, Feb. 17, at $1.04¾ a sq. yd. for brick paving and 34½ cts. a lin. ft. for new straight curbing.

Atlantic City, N. J.—The contract for paving Pacific ave. was awarded to Warner, Quinlan & Co., at $2.23 a sq.

yd. for asphalt paving, 45 cts. a lin. ft. for stone, and $6,006 for drainage.

Cadillac, Mich.—The bd. of pub. wks. voted Feb. 18, to recommend the acceptance of the bid of the Central Bitulithic Co. for paving the streets at $1.60 a sq. yd. for paving, 25 cts. a cu. yd. for excavation, 50 cts. for foundation.

Memphis, Tenn.—Paving contracts were awarded, Feb. 13, as follows: Union ave., H. J. Roper, $11,801.50; Belvedere boulevard, H. W. Brennan, $4,077; N. Montgomery st., Roach & Manigan, $3,710; Gaston ave., H. W. Brennan, $3,497; College st., $2,653, and Pine st., $1,983.20, H. W. Brennan.

North Olean, N. Y.—Bids were submitted, Feb. 13, for constructing 16,000 sq. yds. of paving, with necessary excavation, curbing, street inlets, etc., as follows: G. J. Vedder, $57,619; Dugan & Keenan, $40,110; Hassam Paving Co., $44,233; Morrison & Harris, $45,733; J. F. Kirwin & Co., $43,036; J. C. Swanson & Co., $40,523; W. H. Simpson, $42,439; R. W. Henson, $42,614; S. C. Hull, $43,705; Wisdom Paving Co., $47,008; Franklin Construction Co., $49,691; McNicoll & O'Connor, $49,524; Hageman, Miller & Hogan, $42,441; James Nixon, $46,928. Bids were based on Kushequa repressed brick except J. C. Swanson & Co. and James Nixon, who bid on Jamestown repressed brick.

St. Louis, Mo.—Paving contracts were awarded, Feb. 14, as follows: Pine st. from 3d to 4th, United States Wood Preserving Co., $3,398.50; 3d st. from Chestnut to Pine, United States Wood Preserving Company, $3,014.70; Florissant av. from Hebert to Salisbury, Heman Construction Co., $15,022.75; College ave., from Von Phul st. to Florissant av., James E. Perkinson, $26,457.20; College av. from Broadway to Von Phul, Heman Construction Co., $5,536.40; Margaretta av. from Newstead to Taylor, Skrainka Construction Co., $10,135.27; Neosho st. from Broadway to Compton, Wm. R. Bush Construction Co., $19,211.25; Itaska from Broadway to Virginia, G. Eyermann & Bro., $24,253.70; Michigan av. from Delor to Neosho, Wm. R. Bush Construction Co., $11,270.22; Koeln av. from Broadway to Pennsylvania, Ruecking Construction Co., $3,020.56; Arsenal st. from Spring av. to Morgan Ford rd., Granite Bituminous Paving Co., $52,372.20; King's Highway boulevard from Old Manchester to Eager road, Granite Bituminous Paving Co., $49,855.65; Bremen av. from Wharf to 1st st., Heman Construction Co., $19,976.90; Old Manchester av. from King's Highway boulevard to January av., Fruin-Bambrick Construction Co., $56,330.10.

Albany, N. Y.—Contracts for improving state highways have been awarded as follows: To Twombly & Eldert, Jamaica, L. I., N. Y.: No. 543, Nassau county, $47,555. To Brown & Lowe, Schenectady, N. Y.: No. 561, Sec. 1, Oneida county, $46,000; No. 562, Sec. 2, Oneida county, $37,685; No. 563, Oneida county, $49,660. To Stewart-Kerbaugh-Shanley Co., 527 5th av., New York: Erie county, $76,011; No. 695, Cattaraugus county, $11,794; No. 696, Sec. 1, Cattaraugus county, $33,907; No. 697, Sec. 2, Cattaraugus county, $17,363; No. 726, Sec. 2, Madison county, $77,721; No. 541, Fulton county, $49,773. To M. L. Siver & Co., Sidney, N. Y.: No. 599, Chenango county, $60,170; No. 677, Otsego county, $43,815. To Malloy & Davis, Schenectady, N. Y.: No. 641, Schenectady county, $33,545. To Bellew & Merritt Co., Tuckahoe, N. Y.: No. 693, Suffolk county, $29,502; No. 689, Rockland county, $32,831; No. 700, Sec. 2, Sullivan county, $44,939; No. 743, Suffolk county, $38,081. To P. F. Herlihy, Glens Falls, N. Y.: No. 692, Warren county, $76,102. To Roberts & Gerhart Contracting Co., New York: No. 694, Suffolk county, $66,097. To Elmer L. Love & Sons, Corry, Pa.: No. 698, Chautauqua county, $9,846. To John F. Clancy, Long Island City, N. Y.: No. 699, Sec. 1, Sullivan county, $56,022. To Buckley Construction Co., Plattsburg, N. Y.: No. 701, Franklin county, $34,327. To Spuyten Duyvil Construction Co., New York: No. 702, Sec. 2, Franklin county, $43,229; No. 703, Sec. 3, Franklin county, $32,069. To John E. Consaulis, New York: No. 719, Sec. 2, Greene county, $37,895. To Linehan & Burnham Co., Glens Falls, N. Y.: No. 720, Washington county, $35,350. To John E. Quinn, Brooklyn, N. Y.: No. 721, Washington county, $24,355. To Hinman & Sproul, Schenectady, N. Y.: No. 722, Washington county, $18,328. To Starr Contracting Co., Glens Falls, N. Y.: No. 730, Sec. 1, Cattaraugus county, $29,731.90; Portville-Olean rd. No. 731, Sec. 2, Cattaraugus county, $19,619. To Ryan & Yale, Brewster, N. Y.: No. 732, Sec. 1, St. Lawrence county, $64,472; No. 733, Sec. 2, St. Lawrence county, $67,016. To Bradley & Nolan, Corning, N. Y.: No. 742, Steuben county, $48,185. To Charles H. Flanigan, Albany, N. Y.: No. 691, Warren county, $46,324.

SEWERS.

CONTEMPLATED WORK.

Rio Vista, Cal.—A sewerage system is proposed.

Cudahy, Wis.—Sewer extensions are contemplated.

Beaver, Pa.—Voted to issue bonds for installing a sewerage system.

Norman, Ok.—Voted to issue bonds for constructing a sewerage system.

Greenville, Pa.—This city will have to build a sewage disposal plant.

Hope, Ark.—A sewerage and water works system is contemplated.

Aurora, Minn.—Voted to issue bonds for constructing a sewerage system.

Lufkin, Tex.—A sewerage system is contemplated by the business men of this city.

Athens, Ga.—Will vote on the issue of bonds for constructing sewers.

Springfield, Mo.—Sam Fisher, asst. cy. engr., is preparing plans for a sewer in dist. No. 12.

West Hartford, Conn.—Plans are being prepared for constructing a sewer in Park st.

Vincennes, Ind.—The city engineer is preparing plans for constructing a concrete sewer.

Chattanooga, Tenn.—The question of constructing a cross-town sewer is being investigated.

Staples, Minn.—A resolution has been passed to extend the sewerage system. C. B. Cashman, cy. clk.

Davenport, Ia.—Preliminary surveys have been completed for the proposed west end sewer.

Comanche, Tex.—City council voted to issue bonds for improving the sewerage system. Mayor Burks.

Traer, Ia.—Plans and specifications have been prepared for constructing a complete sewerage system.

Knoxville, Tenn.—The question of constructing more sewers in East Knoxville and the 11th ward is being urged.

Santa Cruz, Cal.—The city engineer has been directed to prepare plans for a sewer in Plateau ave.

Seattle, Wash.—Plans are being prepared for building a trunk sewer in one of the downtown business streets.

St. Charles, Ill.—Plans are being made for constructing a main trunk line sewer, which will eventually embrace an entire system.

Springfield, O.—The committee on sewers, drains and ditches recommend the construction of a sewer in W. Columbia and W. Main sts.

Webster Groves, Mo.—The cost and methods of building several miles of sewers in Old Orchard and Tuxedo Park are being investigated.

St. Paul, Minn.—Specifications have been prepared for constructing more than a mile of sewer in the 6th ward.

Pottsville, Pa.—The state health inspectors will probably ask this borough to build a sewage filtration system.

Hereford, Tex.—The feasibility of issuing bonds for constructing a sewerage system is under construction.

Minonk, Ill.—A resolution has been adopted providing for the construction of a sewerage system. S. A. Miller, supt. sts.

Brazil, Ind.—City Engineer Fletcher is preparing plans for constructing the Pogue's Run trunk and sanitary sewer.

Dallas, Tex.—The construction of a septic tank sewage disposal system is under consideration. The question will be voted on in April.

El Paso, Tex.—Mayor Sweeney has submitted to Mayor Mateus, of Juarez, a plan for erecting a large septic tank for the sewage disposal of both cities.

Grand Rapids, Mich.—The residents of the village of East Grand Rapids are considering the advisability of securing the right from this city to construct a trunk sewer.

Michigan City, Ind.—Mayor Frederick C. Miller and Edward C. Hanley and North W. Ripple visited Baltimore and other Eastern cities recently to investigate sewerage systems.

Moline, Ill.—Surveys have been completed by Clark G. Anderson, cy. engr., for the proposed 6th ward sewer district, which provide for about 5½ mis. of sewers and 2¾ mis. of water mains.

Hartington, Neb.—Special. City council has employed Arnold C. Koenig, cons. engr., Omaha, Neb., to prepare plans and specifications for a complete system of sanitary sewerage and storm water sewers for the business district. Surveys are being made and bids for constructing the main sewers will probably be asked for in the spring.

Santa Monica, Cal.—Special. The detail plans to conform to the general plan for a reinforced concrete wharf which is to be constructed and extending into the Pacific Ocean at the foot of Colorado ave. for a distance of 1,600 ft. from mean tide line, brought 16 plans in all from architects and engineers. The board of engineers, consisting of H. Hawgood, C. H. Ellison and Thomas H. James, recommended that the detail plans submitted by Edwin H. Warner, of Los Angeles, to be the most feasible and best plan in accordance to the requirements, etc. City council adopted his plans and bids will be asked within a reasonable time for constructing the wharf. Thos. H. James, cy. engr.

CONTRACTS TO BE LET.

Frankfort, Ind.—Bids are asked until Mar. 4 for constructing a ditch. Wm. A. Robison, drainage comr.

Gary, Ind.—Bids are asked until Mar. 10 for constructing sewers. Thos. E. Knotts, chmn. bd. town trustees.

Joliet, Ill.—Bids are asked until Mar. 2 for constructing manholes, catchbasins, sewer connections, etc. Bd. local impvts.

Jackson, O.—Bids are asked until Mar. 25 for constructing about 1½ mis. of sanitary sewer. A contract will be let later in the season for about the same amount. J. W. Turner, engr.; D. L. Lewis, clk.

Charleston, Miss.—Bids are asked until Mar. 3 for constructing a main ditch 4 mis. long. E. Bacon, secy. co. drainage comrs.

Menominee, Mich.—Bids are asked until Mar. 16 for constructing sewers in Holmes and Marinette aves. F. S. Norcross, cy. clk.

Fessenden, N. D.—Bids are asked until 2 p. m. Mar. 3 for furnishing 1 car of galvanized corrugated metal culverts. Fred Dix, co. audt.

Ludington, Mich.—Sealed bids are asked until 2 p. m. Mar. 2 for constructing sewers in a number of streets. Fred Gallie, cy. clk.

Aurora, Ind.—Sealed bids are asked until 7 p. m. Mar. 2 for constructing a district sewer in dist. No. 1. Frank D. Johnston, cy. clk.

Lakemills, Wis.—Bids are asked until Mar. 3 for constructing 771 ft. 8-in. and 1,229 ft. 6-in. pipe sewers, 6 manholes, etc. N. H. Falk, cy. clk.

Ottawa, O.—Sealed bids are asked until Mar. 14 for constructing the Buckeye Stave Company ditch, in Liberty twp. J. T. Maidlow, co. surv.

Wellington, Kas.—Bids are asked until Mar. 23 for constructing 3¼ mis. of 6, 8, 10 and 12-in. pipe sewers. H. A. Rowland, cons. engr., McPherson, Kas.

Notre Dame de Grace, Canada—Sealed bids are asked until Mar. 14 for constructing a main outlet sewer for this town. L. Descarries, secy.-treas., Main st.

Pittsburg, Pa.—Bids are asked until Mar. 2 for constructing a terra cotta sanitary sewerage system for Chartiers twp. R. E. Murray, engr., Union Bank Bldg.

Marquette, Mich.—Bids are asked until 3 p. m. Mar. 3 for constructing tile sewers, manholes and lampholes. Joseph F. Anderson, clk. park, cemetery and st. comn.

Patton, Cal.—Bids are asked until Mar. 16 for improving and rectifying certain storm water channels on the grounds of Southern Cal. State Hospital. Dr. A. P. Williamson.

Harrisburg, Pa.—Sealed bids are asked until Mar. 6 for constructing works to control floods in Paxton Creek Valley and all necessary appurtenances. D. E. Tracy, secy. B. P. W.

St. Marys, Pa.—Sealed bids are asked until Mar. 30 for furnishing terra cotta pipe and fittings to be used in

the construction of a sanitary sewerage system. L. C. Hanhauser, boro. secy.

Louisville, Ky.—Bids are asked until Mar. 12 for constructing sec. A of the Beargrass intercepter, requiring 3,500 cu. yds. concrete, 3 classes, 24,000 lin. ft. piles, 126,000 lbs. reinforcing bars, etc. P. L. Atherton, chmn. sewer comrs.

Auburn, N. Y.—Sealed bids are asked until 8 p. m. Mar. 17 for constructing sewers and appurtenances and disposal works. The sewers will consist of 14,700 ft. of 8-in., 11,300 ft. 10-in., 6,000 ft. 12-in., 3,600 ft. 15-in., 300 ft. 18-in. and 1,250 ft. 20-in. pipe. The excavation varies in depth from 5 to 18 ft. and will approximate 16,000 cu. yds., partly in solid rock. There will be 17,000 ft. 5-in. vitrified tile for house sewer connections, to be laid from the main sewer to the curb line. In the main trench and underneath the main sewer, as ground water demands, will be sub-soil drains as follows: 20,000 ft. 4-in., 6,000 ft. 6-in., 7,000 ft. 8-in., 2,000 ft. 10-in. and 200 ft. 12-in. All of the sub-soil drain tile is to be of vitrified tile known as seconds; 84 man holes, 12 flushtanks and 12 lampholes. The disposal works consist of reinforced concrete septic tanks and contact beds and automatic appliances. J. S. Hanlon, cy. clk.

CONTRACTS AWARDED.

Farmer City, Ill.—Plans are being made for a sewerage system.

Wallingford, Conn.—Contracts for constructing sewers in certain streets were awarded to Gannon & Kavanagh, of this city.

Woodstock, Ill.—Charles E. Glertz & Son, of Elgin, secured the contract for constructing a sewerage system for $74,000.

Tecumseh, Mich.—The contract for constructing about 55,769 ft. of sewers was awarded to A. P. Southworth, of Adrian, for $35,338.

Uniontown, Pa.—The contract for constructing a vitrified tile sewer in Gallatin ave. was awarded to W. C. McCormick, of this city.

Mangum, Ok.—The contract for extending the sewer and water-works systems was awarded to the Stoke Bouse Contracting Co., for $45,000.

Chester, Pa.—The contract for constructing a 24-in. terra cotta pipe sewer in Edgmont ave. was awarded to J. Hanna & Sons, at $1.98 a lin. ft.

Wabash, Ind.—The contract for constructing the Southwest 2nd st. sewer system was awarded to Hipskind & Son, of Wabash, for $44,457.58.

Cartersville, Mo.—The contract for constructing a sewerage system was awarded to the J. W. Watson Construction Co., of St. Louis, for $13,309.64.

New York City—Special. The Wemlinger Steel Piling Co., 11 Broadway, New York City, was awarded the contract for constructing the Hillcrest storm sewer in Summit, N. J.

Bartlesville, Ok.—The contract for constructing 34,500 ft. of 8, 10, 12 and 15-in. sewers was awarded to the R. J. & Wm. Boyd Construction Co., of Kansas City, Mo., for $33,850.

Hattiesburg, Miss.—The contract for constructing 2,000 ft. 12-inch., 15,150 ft. 8-in. sewer, 7 flush tanks, 90 manholes, etc., was awarded to T. P. Crymes, of this city, Feb. 10, for $38,700.

Baltimore, Md.—Bids were submitted Feb. 25 for constructing a low-level sanitary intercepting sewer, from the Warren F. Brenizer Co., of Washington, D. C.; Donovan & Phillips, of Boston; McLean Contracting Co., of Boston.

Washington, D. C.—The contract for constructing a sewer was awarded to the Warren F. Brenizer Co., city, as follows: Ordinary excavation, 66 cts.; sewer brick masonry, $16.50; 21-in. diameter pipe, $1.06; 18-in. pipe, 97 cts.; 15-in. pipe, 61 cts.; 12-in. pipe, 71 cts.

WATER WORKS.

Pineville, W. Va.—The Pineville Water-Light Co. has been incorporated by R. A. Keller, W. B. McClure, A. M. Stewart and others.

Bangor, Me.—The work of construction of the new sedimentation basin at the water-works plant is about completed and will be ready for operation about Mar. 15.

CONTEMPLATED WORK.

Salem, Ill.—A water-works system is contemplated.

Julietta, Ida.—A water-works system is contemplated.

Winchester, Ill.—A water-works system is proposed.

Fenton, Ia.—A water-works system is contemplated.

Morocco, Ind.—Will vote on the question of installing a water-works system.

Yankton, S. D.—The construction of a new water-works system is contemplated.

McClusky, N. D.—Estimates may be asked for constructing a water-works system.

Norman, Ok.—Voted to issue bonds for the extension of the water-works system.

Altus, Ok.—The issue of $50,000 bonds for constructing water-works is authorized.

Klamath Falls, Ore.—A municipal water-works and electric light plant is contemplated.

Cleveland, O.—An ordinance has been passed appropriating $65,000 for a filtration plant site.

Council Bluffs, Ia.—Bids will probably be received in May for the proposed water-works system.

Buffalo, Minn.—May vote on the issue of bonds for constructing a water-works and light plant.

Wenatchee, Wash.—Town council is considering estimates of the cost of installing a pumping plant.

Minneapolis, Minn.—The establishment of a filtration plant for the water-works system is contemplated.

Montreal, Que.—Plans are being considered for the enlargement of the aqueduct for a greater water supply.

Evansville, Ind.—Council has passed a resolution endorsing a mechanical filtration plant for this city.

Moberly, Mo.—Bids will be received about April 1 for constructing a water-works system. J. F. Curry, cy. clk.

Ft. Smith, Ark.—This city contemplates the purchase of the present water plant or the construction of a new system.

Anamosa, Ia.—Council has decided to employ George C. Morgan, of Chicago,

to make plans for a water-works system.

Canon City, Colo.—An ordinance has passed first reading authorizing this city to construct a gravity water-works system.

Columbia, Miss.—Plans and specifications for constructing a water-works system will be made by X. A. Kramer, of Magnolia, Miss.

Watertown, S. D.—City council has decided to take steps towards purchasing the present water-works system or building a new one.

Sapulpa, Ok.—This city has engaged A. Earl & Co., of Muskogee, Ok., as consulting engineers on the proposed water-works improvements.

Birmingham, Ala.—The town council of North Birmingham is considering the question of issuing bonds for acquiring a municipal water-works plant.

Webster City, Ia.—City Engineer Mullins has been directed to prepare estimates showing the cost of constructing 4 new wells for the city water supply.

Newark, N. J.—Common council has applied to the State Water Supply Commission for the right to construct an additional reservoir on Kilkeout reservoir site.

Lawrence, Mass.—A. D. Marble, cy. engr., has been directed to prepare plans and estimates for covering the old filter bed, placing concrete bottom and sides to it.

Rock Island, Ill.—Mayor Schaffer has recommended the necessity of considering plans for a new filtration plant for this city, the present sand filtration plant having become inadequate.

Urbana, Va.—The Business Men's Association has been organized here, and has passed a resolution to ask the town council to have plans and specifications prepared for constructing a water-works system.

CONTRACTS TO BE LET.

Rome, Ga.—Bids are asked until Mar. 9 for 1 gravity filter. M. L. Worrell, supt.

Dallas, Tex.—Sealed bids are asked until Mar. 3 for furnishing a pump. J. B. Winslett, cy. secy.

Rushford, Minn.—Bids are asked until April 8 for extending the water-works about 1,000 ft. C. O. Alm, cy. clk.

Childress, Tex.—Bids are asked until Mar. 3 for constructing a water-works system. Joseph H. Aynesworth, cy. secy.

Toledo, O.—Bids are asked until Mar. 4 for furnishing 850 tons of 24-in. c. i. pipe, etc. Reynold Void, secy. B. P. S.

Oakland, Cal.—Bids are asked until Mar. 18 for constructing a salt water pumping plant. Walter B. Fawcett, secy. B. P. W.

Columbus, O.—Sealed bids are asked until Mar. 6 for furnishing c. i. pipe, special castings, etc. E. W. Hirsch, secy. B. P. S.

Buffalo, N. Y.—Bids are asked until Mar. 14 for constructing concrete walls for Ship Lock, Black Rock Harbor. H. M. Adams, Col. engrs.

Mendham, N. J.—Bids are asked until Mar. 10 for furnishing materials and constructing a water-works system. E. W. Elliott, mayor.

Brooklyn, N. Y.—Bids are asked until Mar. 4 for furnishing and delivering corporation cocks. John H. O'Brien, comr. water sup. etc.

Ft. Sheridan, Ill.—Bids are asked until Mar. 2 for the extension of the water distributing system. Lieut. B. F. Miller, constr. Q. M.

Philadelphia, Pa.—Bids are asked until Mar. 3 for furnishing pumping engines for Roxboro and Belmont stations. Wm. R. Knight, dir. bureau of water.

Elkhart, Ind.—Bids are asked until Mar. 11 for a 25-yr. franchise for supplying water for all domestic and public uses. A. T. Maltby, cons. engr., Chicago.

Washington, D. C.—Bids are asked until April 15 for constructing Clear Lake dam and dikes, about 55 mis. southeast from Klamath Falls, Klamath Project, Oregon-California. U. S. Reclamation Service, Portland, Ore.

CONTRACTS AWARDED.

Logansport, Ind.—W. H. Hayworth was awarded the contract for sinking an artesian well in McKinley Park, at $1.35 a ft.

Columbus, Ga.—The contract for furnishing this city with water was awarded to the Hudson Engineering Co., of New York City.

Commerce, Ga.—The contract for constructing a water-works system was awarded to J. B. McCrary & Co., of Atlanta, Ga., for $36,000.

Quincy, Ill.—The contract for 4,500 ft. of 12-in. c. i. pipe was awarded to the American C. I. Pipe Co., of Birmingham, Ala., for $7,000.

Berrien Springs, Mich.—The contract for constructing a water-works system was awarded to the C. L. Olds Construction Co., of Ft. Wayne, Ind.

North Yakima, Wash.—The contract for constructing a dam for the Pleasant Valley Irrigation Co., in the East Selah valley, was awarded to Case & Esbach.

Lawrence, Mass.—The contract for furnishing 6 and 12-in. pipe at $25.05 and 4-in. pipe at $26.05, was awarded to R. D. Wood & Co., 400 Chestnut st., Phila.

Norway, Mo.—The contract for constructing a 1,000,000-gal. reservoir and laying pipe was awarded to John E. Palmer, 1012 Old South Bldg., Boston, Mass.

Aurora, Ill.—The contract for furnishing a new air compressor for the water-works was awarded to the American Well Works Co., of this city, for $15,875.

South Bend, Ind.—Contracts have been awarded as follows: For water meters, Thompson Meter Co., Brooklyn, N. Y., 25 1-in., at $16.80 each, and 50 ⅝-in., at $8.40 each; Union Water Meter Co., Worcester, Mass., 50 ⅝-in., at $8 each; Pittsburg Meter Co., 50 ⅝-in., at $8.40 each; H. R. Worthington Co., Chicago, Ill., 50 ⅝-in., at $7.35 each.

Oklahoma City, Ok.—The contract for furnishing 895 tons of c. i. pipe at $27.85 a ton and 10 tons of bell and spigot castings at 3 cts. a lb., to be used in the extension of the water-works system, was awarded to the Dimmick Pipe Co., of St. Louis, Mo.

BRIDGES.

Goshen, Ind.—Bids will be asked soon for constructing a bridge over

Pine River.

Superior, Wis.—Plans are being prepared for erecting a bridge over the St. Louis river.

Batesville, Ark.—The question of building a free bridge across White river is being agitated.

Neligh, Neb.—Bids are asked until Mar. 3 for constructing a steel bridge. W. H. Block, com. on roads and bridges.

Rensselaer, Ind.—Bids are asked until Mar. 2 for constructing a steel bridge in Milroy twp. Jas. N. Leatherman, co. audt.

Baltimore, Md.—Bids are asked until Mar. 11 for constructing reinforced concrete and steel piers. O. F. Lackey, harbor engr.

Dunrea, Man.—Bids are asked until Mar. 10 for constructing a steel or reinforced concrete bridge. J. H. Putnam, town treas.

Baltic, O.—Bids are asked until Mar. 2 for constructing the superstructure for a concrete bridge here. A. V. Denahey, co. audt.

Malta, Colo.—Bids are asked until Mar. 6 for constructing a reinforced concrete bridge across Arkansas river. T. W. Jaycox, state engr.

Indianapolis, Ind.—The contract for repairing the Virginia ave. viaduct was awarded to the Indiana Bridge Co., of Muncie, for $5,900.

Cleveland, O.—Bids are asked until Mar. 14 for constructing a steel concrete bridge in Euclid twp. Wm. F. Black, clk. co. comrs.

Birmingham, Ala.—Bids are asked until Mar. 10 for constructing 8 steel or reinforced concrete highway bridges. P. S. Milner, co. engr.

New Philadelphia, O.—Bids are asked until Mar. 2 for repairs to the steel bridge on Wooster st., Canal Dover, O. A. V. Denahey, co. audt.

Cleveland, O.—Sealed bids are asked until Mar. 7 for constructing a bridge and movable dam across the Chippewa river at Shawtown. J. C. Fennessey, cy. clk.

Milwaukee, Wis.—Sealed bids are asked until Mar. 17 for constructing a bascule bridge across the Kinnickinnic river at Kinnickinnic ave. Chas. J. Poetsch, chmn. B. P. W.

STREET LIGHTING.

Minneapolis, Minn.—A municipal lighting plant is contemplated.

Guntersville, Ala.—An electric light plant is contemplated.

Huntsville, Ala.—The question of establishing a municipal electric lighting plant is being agitated.

Sheboygan Falls, Wis.—Bids are asked until Mar. 16 for establishing an electric light plant. Vil. trustees.

Mt. Vernon, Ind.—Bids are asked until April 1 for lighting the streets for 10 yrs. with electricity. Henry Kling, cy. clk.

Carthage, Ill.—Bids are asked until Mar. 3 for electric light fixtures for the new court house. J. W. Westfall, co. clk.

Morganza, Pa.—Bids are asked until Mar. 3 for installing an electric light plant within the present power house. Bd. mngrs. Penn. Reform School.

Lecompte, La.—Bids are asked until April 7 for constructing an electric light plant operated by steam. W. H. Jones, clk.

Wilmington, Del.—Bids are asked until Mar 1 (extension of time), for lighting the streets of this city with electricity and gas. Howard B. Griffith, cy. engr.

Moline, Ill.—The village of East Moline has granted two franchises to W. H. Downing, one for gas lighting and one for electric lighting.

Tonowanda, N. Y.—The contract for furnishing power for the new waterworks station was awarded to the Tonawanda Light & Power Co.

Lafayette, Ga.—Bids are asked until May 1 for constructing an electric light plant. J. A. Clements, cy, recdr.

Morristown, N. J.—The Morris & Somerset Electric Co. has been granted a franchise to erect poles and wires and lay conduits for street lighting in the streets and avenues of this township.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

Columbus, O.—Bids are asked until May 11 for constructing garbage reduction works. E. W. Hirsch, secy. B. P. S.

Jersey City, N. J.—Mayor Wittpenn has decided to abolish municipal street cleaning and adopt the contract system again.

Washington, D. C.—The contract for collecting ashes from private dwellings and apartment houses was awarded to the Pollock Drayage Co., for $66,000.

Buffalo, N. Y.—Special. Bids will be asked soon for the collection and removal of garbage and general refuse from public and private buildings. Francis G. Ward, dir, pub.

PARKS.

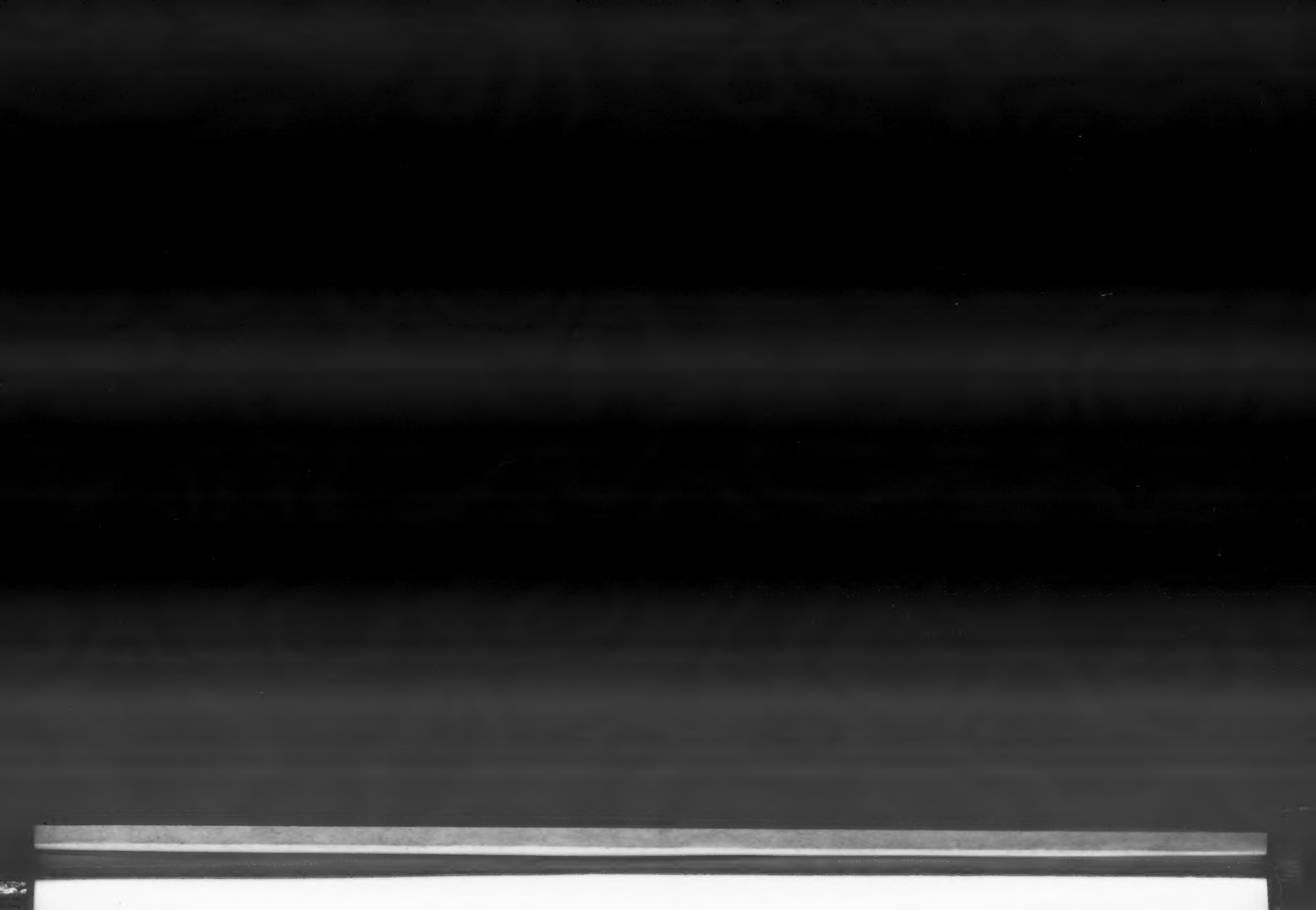
Rutherford, N. J.—Mayor Evans is planning to establish a public playground.

Indianapolis, Ind.—The park board has engaged George E. Kessler for landscape architect.

Minneapolis, Minn.—This city is making active efforts to secure land for the North Minneapolis parkway.

FIRE APPARATUS.

Klamath Falls, Ore.—City council has decided to install a fire alarm system.

Rochester, N. Y.—The Gamewell Fire Alarm Telegraph Co., of New York City, was awarded the contract for furnishing 6 fire alarm boxes.

Chattanooga, Tenn.—The Gamewell Fire Alarm Telegraph Co., of New York City, is installing a Gamewell system of police alarms.